AIR ENGINEERING

DECEMBER, 1960

AIR POLLUTION CONTROL • AIR MOVING • AIR CONDITIONING

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ENGINEERING LIBRARY

- *Air Conditioning At A Jet Engine Plant*
- *Quick Way To Change Radioactive Contaminated Filters*
- *All About Lint-Free Garments For "White Rooms"*
- *Climate Control At Linde Research Laboratory*
- *Air Sanitation With Ultra-Violet Light, Part III*
- *How To Ventilate Bins, Hoppers, Conveyors, Flakers, Blenders*
- *Techniques For Automatically Counting Dust Particles*

Quality Control Methods For Secondary Smelters . . . See P. 33

Ultimately, *somebody* has to get rid of "plant" dust, dirt, smoke and fumes. If the job is left up to neighborhood housewives, the cost to management is exorbitant. Every speck of plant dust settling on a neighborhood is an emissary of ill will that leads, inevitably, to deterioration of plant-neighborhood relations.

The modern (and thrifty) way to attack the problem is with AAF Dust Control applied at all dust sources. This way, dust is trapped the instant it is produced. It never has a chance to irritate workers, arouse neighborhood housewives or run up your own plant cleaning costs.

For complete information on AAF's complete line of dust control equipment, write for "The Answers to the Five Basic Dust Problems" (Bulletin 270-A1). Address: Mr. Robert Moore, American Air Filter Company, Inc., 387 Central Avenue, Louisville 8, Kentucky. In Canada: American Air Filter of Canada, Ltd., 305 Stinson Blvd., Montreal 9.

AAF **American Air Filter**

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in the Chemistry-Geology Building,
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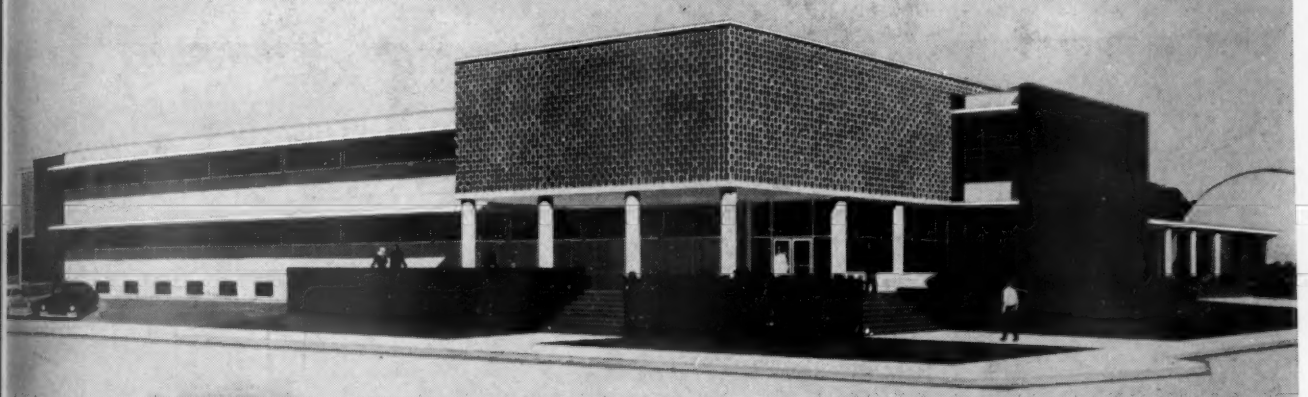

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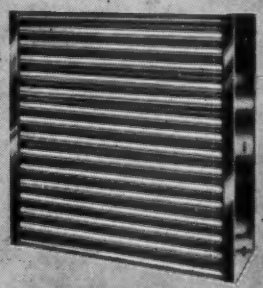
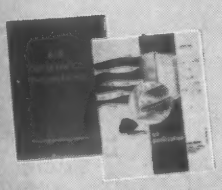
STALE AIR is RECOVERED, RENEWED, READIED for economic RE-USE by DOREX



#52C CELL

Permanent economy in air conditioning system operation is a key concern of architects and engineers alike in their conception and design of modern buildings.
. . . which is precisely why Dorex Air Recovery equipment is a vital part of the air conditioning systems of so many new structures, large and small. It has been proved that air conditioning costs can be cut by 78% annually if a system uses Dorex to recover stale, already conditioned air rather than use 100% outside air.
Here in the new Chemistry-Geology building, San Antonio College, thirty activated carbon Dorex #52 C Cells, designed into the supply air system in the building's fan room, recover the fume-laden, already used air, convert it to original freshness, and bring about maximum economy in the air conditioning process. The thirty cells have a combined air handling capacity of 30,425 cfm.



For more information, request—on your letterhead, please—copies of Bulletin 108A and the textbook, "Air Conservation Engineering" Contact the representative near you or write to Connor direct.

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CONNOR ENGINEERING CORPORATION
dorex® air recovery

. . . the most experienced professionals in air recovery and purification.

Letters

Reader Contributes Data On Filter Replacement

Editor:

In the *Question and Answer* department of the October issue (page 66) you explained why it is not always recommended that an entire bank of filters be replaced at one time. The answer stressed the reduction in the variation of filter pressure drop when only a portion of the bank is replaced. I feel there is another reason for partial replacement that may be more important.

Actually the variation of filter pressure drop has less effect on a properly designed system than might be suspected. Since the pressure drop through the other components of the system generally varies as the square of the air volume, relatively minor changes in the latter cause sizable variations in the pressure drop of these other components and the overall change in air volume is not great.

For example, even with a forward curved blade fan we have found the overall change of air volume was about eight per cent for a system with a total static of 2.5 in. w.g. This increase took

(Please turn to page 6)

COVER

Cover shows a Research Cottrell precipitator at a new chemical plant. Plant was built by United Engineers and Constructors, Inc., Philadelphia, who also furnished the cover plates.

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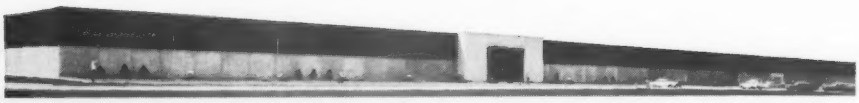

THE AIR IN THIS PLANT IS CLEANER THAN THE AIR A MILE ABOVE IT

The air in this plant has to be clean, because they make precision electronic parts here. It is the Collins Radio Company manufacturing plant in Cedar Rapids, Iowa . . . completely air-conditioned, and electronically air-cleaned with Westinghouse Precipitron®. Collins finds that clean, controlled air pays for itself in fewer rejects, more reliable products, and in reduced absenteeism. Write for our booklet describing the advanced air engineering concept Collins has adopted — based on Westinghouse air handling and air cleaning products. Dept. LA08, Sturtevant Division, Hyde Park 36, Massachusetts. YOU CAN BE SURE . . . IF IT'S **Westinghouse**

J-80708

AIR ENGINEERING

VOL. 2, NO. 12

DECEMBER, 1960

DEDICATED TO THE SCIENCE OF AIR POLLUTION CONTROL
AIR MOVING • AIR CONDITIONING

FEATURES

A Report . . . White Room Symposium 16
Highlights of Phoenix nation-wide meeting with excerpts from important talks and discussions. Information on newly-formed ASCCA.

Unique Air Conditioning System at GE Jet Plant 30
Discussion of central plant, package units, evap cooling with unusual plenum ceiling arrangement for office comfort cooling.

Air Cleaning For The Secondary Smelting Industry 33
Air pollution control and valuable data on non-ferrous smelters and reverbatory furnace air cleaning.

Ventilation For The Chemical Industry 37
How to control air vented from bins, weigh hoppers, similar equipment, with open tee or navy hoods.

Automatic Techniques of Airborne Particle Counting 40
A special report on airborne particle size and concentration in white room areas. Data on Armour Research Foundation automatic particle counter.

Air Filtration at Linde Labs 43
How cleaning maintenance and costs were cut when important research lab switched to new type air filters.

Dust-Free Clothing for White Rooms 44
What material is best for White Room uniforms? How should clothing be designed? These and other questions amply discussed.

Air Sanitation With Ultraviolet Light, Part III 46
Concluding article deals with UV application and techniques for baking and meat-packing industries. Interesting and informative discussion on effects of negative ions.

How To Handle Radioactive Filters 51
How to cut down on time when changing radioactive contaminated filters. What once took 1½ hrs. can now be accomplished in minutes.

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Cross reference three ways for your convenience are all articles published in 1960.

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Overall Industrial Construction Down . . . Defense Related Building Up

According to a report issued by the F. W. Dodge Corporation, non-residential building contracts are expected to drop two percent in 1961, to $11.6 billion, mostly because of reduced outlays for new factory and commercial building construction.

On the other hand, General Motors Corporation plans to spend $1.25-million for new plant, machinery, equipment and tooling for 1961, according to Frederic G. Donner, board chairman. This is an increase of $50-million over 1960. From 75 to 80 percent of the money will be spent in the U.S.

According to a report in U.S. News and World Report (Nov. 14, p. 41) defense related industries will boom. Industries requiring air conditioning and high efficiency air filtration, for example, should forge ahead as orders are upped for more automatic weapons, missiles, electronic equipment.

Underground Schools For The Atomic Age?

At a Building Research Institute meeting recently, an underground school was described by Milo D. Folley, partner, Sargent-Webster-Crenshaw & Folley, architects of Syracuse, N. Y.

Mr. Folley stated that "an underground school can be both functional and pleasant, but above all, economical. Its interior can be colorful and spacious, *with atmosphere controlled for best teaching conditions.*"

First Utility-Operated District Heating and Cooling Plant Built

Claimed to be America's first utility-operated central plant to dispense steam for heating and chilled water for cooling is nearing completion in Hartford, Conn.

Plant is being built by F. H. McGraw and Co., engineers and constructors, for Hartford Gas Co. It will supply, initially, 100,000 lbs of steam, 9000 tons of cooling to Hartford's Constitution Plaza, other new buildings. Later, according to W. T. Webb, president of Hartford Gas, plant capacity will be doubled.

33% Of U.S. Doctors Believe Smoking Causes Cancer . . . 48% Smoke

One-third of the physicians in this country believe cigarette smoking is "a major cause of lung cancer" according to a survey conducted for the American Cancer Society by the University of Chicago's National Opinion Research Center.

The poll showed that 43 percent of the doctors smoke regularly, and five percent smoke occasionally. Of those who don't smoke, 23 percent never did, the rest quit during the past nine years.

Air Pollution Control Bill Caused $7,500,000 Equipment Expenditure

The Bay Area Air Pollution Control District's (San Francisco) recently enacted Regulation No. 2, with a Jan. 1, 1961 deadline for compliance, has already led to expenditures exceeding $7,500,000 in the Bay area, with more than $10-million committed thus far . . . all for air cleaning and related equipment.

DUST PARTICLES ARE SCHIZOPHRENIC

Industrial dusts have split personalities. They can be peace loving, pleasant, and in some cases precious . . . in the proper environment. But let them get out into the open air where they are free to roam and settle where they please! They become unbearable public enemies . . . atmospheric delinquents. Take fine mineral particles, for instance. In their proper setting their brilliance and striking colors would stir the heart of a poet. But who would want them settling from the sky on a white suit or staining a newly painted house? Esthetic beauty in one place can be unwanted ugliness in another.

Let Ducon dust specialists psychoanalyze your industrial dust and prescribe the right treatment to keep it under control. We have a full line of wet and dry dust control devices to solve your problem.

Write for Bulletin C 1058

DUCON — DUST CONTROL SYSTEMS AND EQUIPMENT

the name in DUst CONtrol

THE **Ducon** COMPANY INC.

147 EAST SECOND STREET • MINEOLA, L. I., NEW YORK

CYCLONES • CENTRIFUGAL WASH COLLECTORS • TUBULAR CLOTH FILTERS • DUST VALVES

Canadian Branch:

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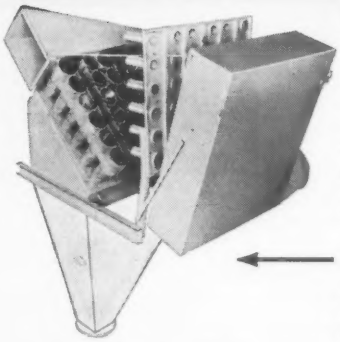
THERE'S THE RIGHT KIND OF DUSTEX COLLECTOR for every dust problem*

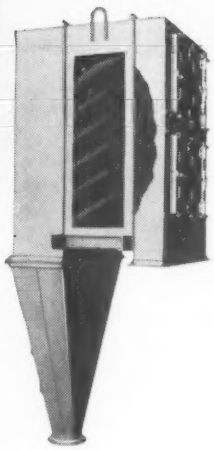


DUSTEX CENTRIFUGAL COLLECTORS →

D-584 with 100% efficiency at 14 microns

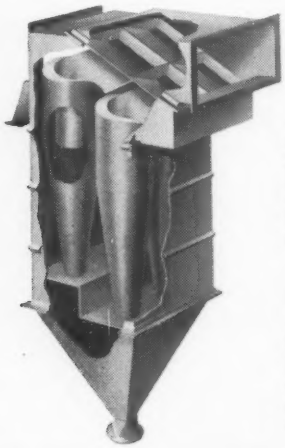
D-560 with 100% efficiency at 12 microns

for economical separation of dust from normal or high temperature gas or air.



← **MICROCLONE**

with 99.8% efficiency at 10 microns and smaller for ultra-high efficiency and installations requiring strict sanitation . . . easily cleaned and sanitized thanks to convenient hinged top tube sheet design.

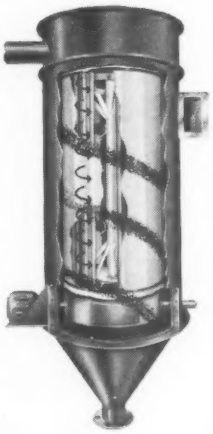


For Many Ordinary Dusts

New, Low-Cost DUSTEX "1600" brings a higher Dustex Performance to collectors in Lower Price Range.

DUSTEX ROTO-JET CLOTH COLLECTOR →

Dustex Engineering eliminates usual cloth problems through a completely new design . . . drastically lowers operating and maintenance costs.



THE BIG DIFFERENCE

IN CENTRIFUGAL COLLECTION

Dustex Exclusive Patented Design

- Unobstructed inlet plenum avoids material buildup and plugging.
- All tubes are surrounded by cleaned gases and maintained at system temperature to forestall condensation and plugging when systems are above dew point.

IN CLOTH COLLECTION

Revolutionary Dustex Advances

- Preliminary separation of dust reduces cloth load.
- No reversing mechanisms.
- Unique controlled wrap prevents cloth jamming.
- Cloth changes easier . . . less frequent.

For all Hopper and Bin Discharges

(Under Negative Pressure)

DUSTEX VACUUM VALVE

No motive power required.
No mechanical parts.
Maintenance free.
Bolt in place and forget it.

ON THE JOB DETERMINATION TEST YOUR BEST GUARANTEE

The Dustex Single Tube Determination Test, performed under actual operating conditions, provides exact data with which to specify equipment. No cost or obligation.

SEND FOR "A Simplified Test Method", illustrated booklet describing the Dustex Single Tube Determination Test in detail.

Details and specifications for every model available on request.

DUSTEX PATENTED FEATURES ARE THE BASIS FOR DUSTEX SUPERIOR PERFORMANCE

*It will pay you to learn why Dustex has so successfully handled so many process dusts where other collectors have failed.

• *The company with the big name in dust collection . .*

Dustex CORP.

P. O. Box 2520 • BUFFALO, NEW YORK

Letters

(Continued from page 2)

place over the full range of filter resistance (0.06 in. w.g. to 0.21 in. w.g.) when all filters were changed at one time. Such a variation is not noticeable in most systems.

A Special Advantage

The advantage of changing only a part of a bank of filters at one time that I would like to stress is that *longer average filter life* is obtained. The reason is not always obvious, and is best explained by an example.

Assume a bank of 30 high efficiency replaceable cartridge type filters operating to a maximum resistance of 0.60 in. w.g., each filter handles 1000 cfm of air. If all filters are replaced at one time, each dirty filter will contain a certain amount of dust which, when placed on a filter handling 1000 cfm of air, raises its resistance to 0.60 in. w.g.

Now suppose that when the bank reaches 0.60 in. w.g. only one third of the filters are replaced. The pressure drop across the bank will be reduced to some intermediate value, say 0.40 in. w.g. After a period of operation again raises the pressure drop of the bank to 0.60 in. w.g., a second one third of the filters are replaced and the process is repeated.

After a complete cycle, a pattern is established so that at any time the bank resistance reaches 0.60 in. w.g. one third of the filters in the bank are very dirty, one third moderately dirty and one third fairly clean. This results from the different periods of time these filters have been in operation.

Under these conditions it is evident that although the system is still passing 30,000 cfm, all filters are not handling their prorated amount of air. The dirtiest third may be handling only 700 cfm each, the intermediate third its regular 1000 cfm and the cleanest third 1300 cfm each. Now the point of all this becomes apparent.

When a filter is removed which has reached 0.60 in. w.g. pressure drop when passing only 700 cfm, it is considerably dirtier than the same type of filter which has 0.60 in. w.g. pressure drop at 1000 cfm.

(Please turn to page 9)

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EDITORIAL:

An Open Letter To Owners . . . For Engineers

BACK WHEN mechanical system costs were only 10 percent or so of total building costs, it didn't matter much whether the engineer's services to the owner were funneled through the architect or not.

Selection of the heating system affected building design and costs relatively little, and the architect generally knew enough about these simple systems to account for them in his design.

It's not that simple today. Mechanical systems as well as buildings are far more complex, they cost far more, and the building design can force a poor and costly mechanical system on the owner. It can, that is, if the engineer is subordinated in the team of owner, builder, architect, to a position of responsibility well below that of the architect.

When the architect is no longer the engineer's client, the engineer is in a position to point out how changes in building design can save the owner substantial sums of money in mechanical costs.

For example, we know of one building, with a luminous, hung ceiling, in which mechanical equipment space occupied 40 percent of building volume for ductwork, shaft space, mechanical and fan rooms. This owner could have had considerably more space for his building dollar if his architect could have been persuaded to integrate some of the mechanical equipment better into the building. A cellular "air-floor" for instance, would have eliminated, in this particular building, much of the shaft space. The floor space itself would have served as the air distribution and electrical distribution system. Since the architect was alone responsible to the owner, the engineer had to put together the best system he could for the building as laid out by the architect. Here the owner suffered a loss in usable floor space because he did not have an engineer directly responsible to guide and advise him.

Separate contracts for mechanical and architectural services will also protect the consulting engineer . . . keep him from being a "whipping boy" when mechanical systems go over budget due to architectural design.

When the engineer and architect are co-equal

(Please turn to following page)

An Open Letter To Owners . . . For Engineers

(Continued from preceding page)

in status and responsibility to the owner, building schedules can be coordinated far more smoothly, thus assuring completion on time. The architect will have far less tendency, for example, to spring loose a job under a time schedule the engineer cannot meet, and still permit the engineer to come up with the best job he can do for his fee.

Advanced new techniques and concepts in building air conditioning systems, can often be worked out only when the consulting engineer reports to the owner. We know of one system, (to be the subject of a full scale article soon in AIR ENGINEERING) where a huge one-story building with a high lighting load, was able to regain heat from that load via a reverse cycle heat pump. Such a system could only have been possible by providing for it in the architectural design stage. The consulting engineer told us he would not have thought along the lines of modifying the building design itself to come up with a better mechanical system for the owner, if the building design were already inflexible.

New equipment, new techniques, tomorrow's improved mechanical air conditioning, air distribution and heating systems, will be incorporated into today's buildings, only if the owner gives the consulting engineer the responsibility his profession deserves, with a separate, direct contractual relationship.

Eugene A. Sloane

Editor

Meetings, Courses, Expositions

Industrial Heating Equipment Association, Inc. meeting, *Dearborn Inn, Dearborn, Mich., Jan. 23-24, 1961.*

Plant Maintenance & Engineering Conference, *International Amphitheatre, (White room discussion to be included) Chicago, Jan. 23-26, 1961.*

National Assn. of Home Builders (annual convention and exposition), *Exposition Center, Chicago, Jan. 29-Feb. 2, 1961.*

Air-Conditioning and Refrigeration Wholesalers (annual convention), *Chicago, Feb. 10-11, 1961.*

National Rural Electric Cooperation Assn. (annual meeting), *Dallas, Texas, Feb. 12-16, 1961.*

American Society of Heating, Refrigerating, and Air-Conditioning Engineers semi-annual meeting and exposition, *International Amphitheatre, Chicago, Feb. 13-16, 1961.*

10th Annual Industrial Ventilation Conference, *Kellogg Center, Michigan State U., East Lansing, Michigan, Feb. 20-23, 1961.*

11th Annual ISA Conference on Instrumentation for the Iron & Steel Industry, *Roosevelt Hotel, Pittsburgh, March 8-10, 1961.*

National Assn. of Corrosion Engineers (annual conference and Corrosion Show), *Statler hotel, Buffalo, N. Y., March 13-17, 1961.*

National Assn. of Refrigerated Warehouses, Inc. and The Refrigeration Research Foundation, *Mark Hopkins Hotel, San Francisco, Calif., March 27-30, 1961.*

3rd Symposium on Temperature—Its Measurement and Control in Science and Industry, *Veteran's Memorial Hall and Deshler-Hilton Hotel, Columbus, Ohio, March 27-31, 1961.*

Gas Appliance Manufacturers Assn., *Boca Raton Hotel, Boca Raton, Florida, April 5-7, 1961.*

American Industrial Hygiene Conference, *Sheraton-Cadillac Hotel, Detroit, April 10-13, 1961.*

7th National ISA Symposium on Instrumental Methods of Analysis, *Shamrock-Hilton Hotel, Houston, Texas, April 17-19, 1961.*

National Assn. of Electrical Distributors (annual convention), *Detroit, April 29-May 3, 1961.*

4th National ISA Power Instrumentation Symposium, *LaSalle Hotel, Chicago, May 8-10, 1961.*

Air Pollution Instrumentation Symposium, *Hotel Commodore, New York, June 12, 1961.*

3rd Biennial International Gas Chromatography Symposium, *Kellogg Center, Michigan State U., East Lansing, Mich., June 13-16, 1961.*

4th International Conference on Bio-Medical Electronics; 14th Conference on Electronic Techniques in Medicine & Biology, *Waldorf-Astoria Hotel, New York, July 9-14, 1961.*

Joint Nuclear Instrumentation Symposium, *North Carolina State College, Raleigh, N. C., Sept. 6-8, 1961.*

ISA Fall Instrument-Automation Conference & Exhibit, *Memorial Sports Arena, Los Angeles, Calif., Sept. 11-15, 1961.*

National Metal Exposition, *Detroit, October 23-27, 1961.*

National Frozen Food Distributors Assn., *Chicago, Nov. 6-10, 1961.*

Air-Conditioning and Refrigeration Institute (annual meeting), *The Homestead, Hot Springs, Virginia, Nov. 12-15, 1961.*

National Warm Air Heating and Air Conditioning Assn. (annual convention), *La Salle Hotel, Chicago, Nov. 13-16, 1961.*

National Electrical Manufacturers Assn. (annual meeting), *Traymore Hotel, Atlantic City, New Jersey, Nov. 13-17, 1961.*

National Assn. of Home Builders, *Exposition Center, Chicago, Dec. 3-7, 1961.*

Letters

(Continued from page 6)

Thus each filter removed when the bank is changed a third at a time is considerably dirtier than a filter removed when all filters are changed at once.

Filter "Life" Expectancy Varies According to Type

It is obvious that if each filter changed removes more dirt, the average life of the filters is increased. The amount of this increase varies with the type of filter employed and the final pressure drop. It usually amounts to a saving of from 20 percent to 30 percent in filter replacement cost.

Although the figures given in the example vary, the above analysis applies to a wide range of filters ranging from high efficiency pleated types to throwaway and cleanable panel types.

There are two possible disadvantages in this method of filter replacement. First is the necessity of doing some servicing at more frequent intervals. On very large installations this may actually be an advantage, however, since it limits the amount of servicing to be done at any one time.

The second disadvantage is that since all the filters are not handling the same amount of air, the velocity distribution downstream of the filters will not be exactly uniform. This is usually not sufficiently severe to affect coil performance however. Travelling media filters give the same type of uneven distribution.

This possible problem can be alleviated by dividing the sections to be changed at one time vertically rather than horizontally, as is the case with most roll media filters.

Paul M. Engle
Cambridge Filter Corp.
Syracuse, N. Y.

Wants Specific AE Issue

Editor:

The Division of Air Pollution Control in the City of Cleveland has subscribed to AIR ENGINEERING and so has the writer. We would

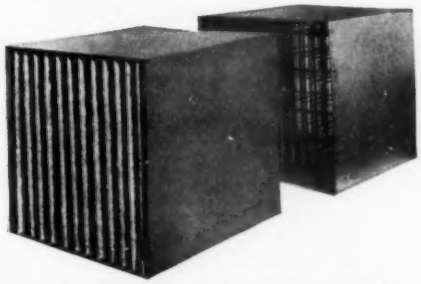
(Please turn to page 12)

United Engineering Center
United Nations Plaza, New York City

Showcase **for the last word in design for comfort and convenience**

Among the many modern design features of the United Engineering Center is the air-conditioning and ventilation complex of twelve separate systems, totaling 244,400 cfm.

Cambridge AEROSOLVE® 85 Filters Provide Positive, High-Efficiency Air Cleaning



The 24″ deep AEROSOLVE filters in the United Engineering Center operate at an NBS efficiency of 85% on atmospheric dust (dust spot test method) and at a face velocity of 450 fpm. Each filter, with a face area of 24″ x 24″, handles 1800 cfm. 86 sq. ft. of special glass fiber medium in each cartridge provides exceptionally high dirt-holding capacity and long service life.

No maintenance is required beyond infrequent replacement of the preformed cartridges.

Interchangeable cartridges of 95%, 85% and 35% efficiency are available to meet the requirements of a wide range of comfort-conditioning and ventilation applications.

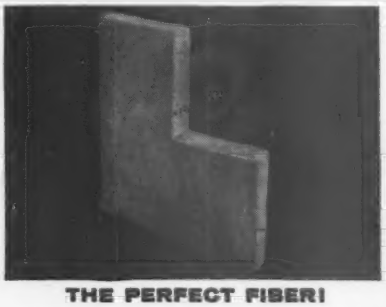
Write for Bulletin 132

Cambridge Filter Corporation
744 East Erie Boulevard, Syracuse 1, N. Y.

THE STARTLING FACTS ON THE

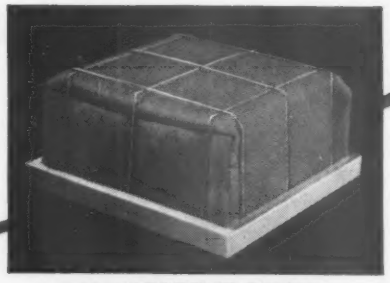
New ULOK Cube

BRAND



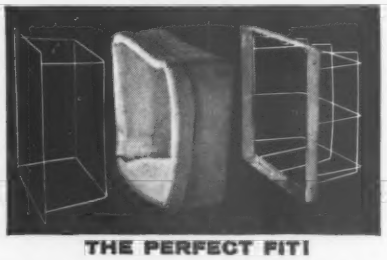
THE PERFECT FIBER!

UNION CARBIDE research has produced the truly ideal filter medium in DYNEL modacrylic fiber—a strong, high capacity fiber with an irregular, highly arresting cross section.



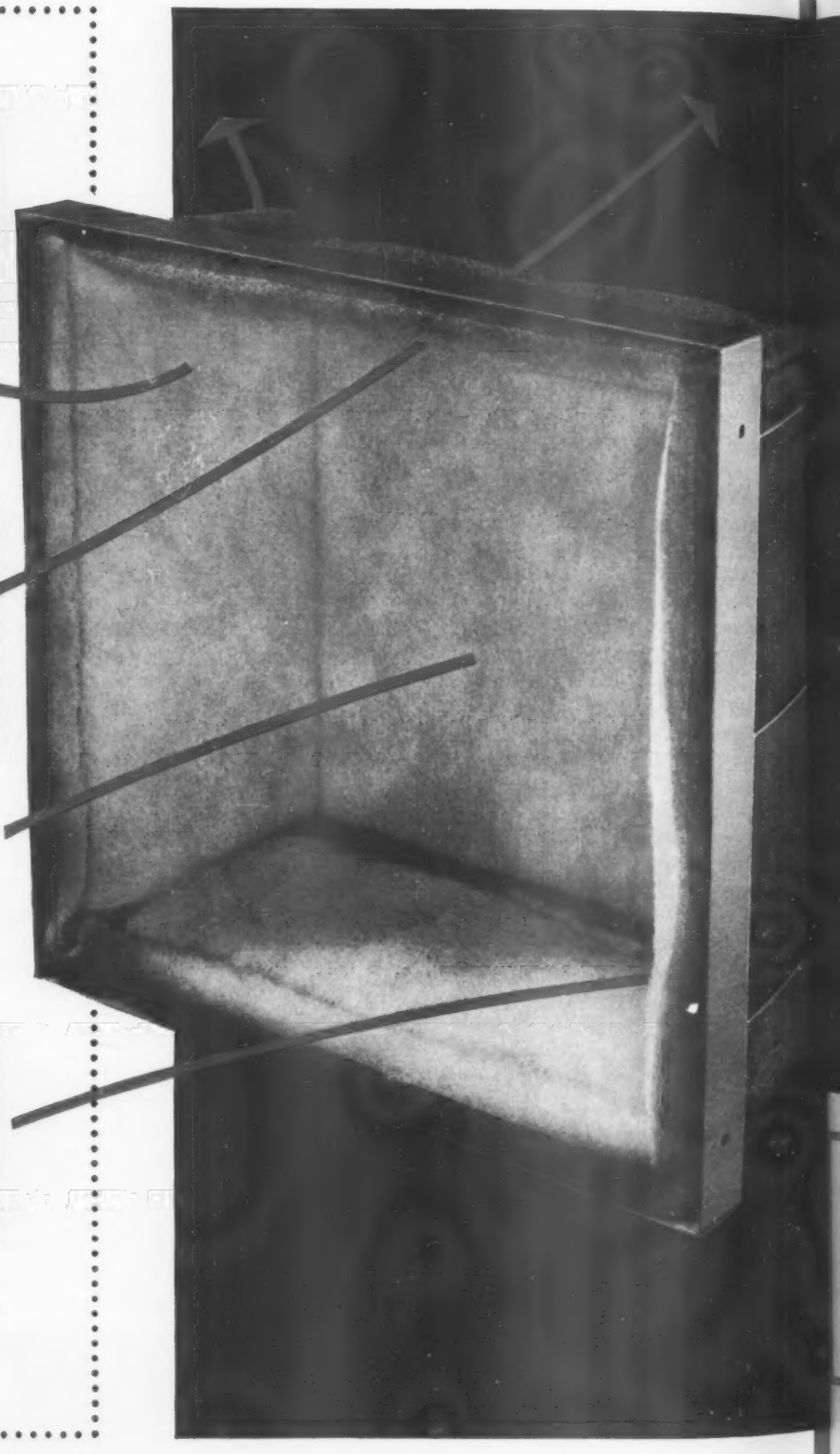
THE PERFECT FORM!

Basic component is a low density, three-dimensional batt, sewed into cube shape. Rust-proof retainer frame is inserted in batt, then batt is inserted in wire retaining basket. Final three-piece assembly is supported by holding frame within unit, is easy to handle—no sharp edges or "splinters". Easy to dispose of when full—simply collapse and discard . . . the dust is in the bag!



THE PERFECT FIT!

Shape of retainer frame inside batt permits filter to seal itself in holding frame. Final filter assembly is a tight, leak-proof, press fit.



Type Air Filter:

New Filter Medium!

DYNEL filter medium stops and holds unusually large quantities of dirt. Self-sealing, leak-proof assembly completely eliminates problem of filter bypass . . . provides maximum economy at highly acceptable filtration levels.

Saves Change-Over Dollars!

ULOK Cube Filter lasts 6 times longer. Dirt is first trapped on inside face of filter. As dirt builds up, air flow is shunted to large filtering area of four sides. Thus, even after several *pounds* of dirt have been collected, high filtering efficiency and low pressure drop is maintained. This "reverse loading" process increases service life *6 times* over that of conventional filters. Think of the savings in maintenance!

Uses Half The Space!

Medium-size ULOK Cube Filter has a filtering surface of 1040 sq. in.—140 more than a conventional 30″ x 30″ flat filter—yet it presents a frontal area of only 20″ x 20″. Filter bank area can thus be reduced by *half* with medium-depth filter, *even more* with deeper models.

At All Velocities!

ULOK Cube Type Air Filters afford the high filtering efficiency characteristic of low velocity units even in units employing air volumes as high as 1970 cfm!

Proved In Operation!

ULOK Cube Type Air Filters have been soundly proved in numerous installations. Reflecting a complete range of the filtering problems presented under varying operating conditions, these field trials were complemented by extensive and extremely severe laboratory tests.

Ideal for all commercial and industrial air conditioning, heating, and ventilating systems, ULOK Cube Type Air Filters are available in 12 sizes to meet any requirement.

WRITE TODAY FOR FURTHER INFORMATION AND PRICES.

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UNION CARBIDE DEVELOPMENT COMPANY

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Letters

(Continued from page 9)

like to have two complete files of this fine publication.

I am missing Vol. 1, No. 2 of May 1959. Can you supply me with a copy?

John L. Hodges, Chief
Bureau of Smoke Abatement
City of Cleveland (Ohio)

Requests More Ion Data

Editor:

With reference to your article on negative ions (p. 13, March, 1960) I would like to see more articles on this subject, especially with reference to air conditioning.

Also, with respect to air pollution, what concentration of negative ions exist in free air . . . how is ion concentration measured, etc.?

J. R. Metzler
Technician
U.S. Weather Bureau
Reno, Nev.

Editor's Note:

First, we are preparing a thorough article in depth on all aspects of negative ions. With respect to the second part of Mr. Metzler's letter, how is ion concentration measured, we welcome suggestions from readers on this subject.

We also have another reader who wants to know where he can buy a commercial scale negative ion generator. Since we know of no firm who makes a large negative ion generator for installation in larger commercial air conditioning systems, we welcome any information as to source of these units. In addition we would also like to have your installation and operating experience if you have installations of negative ion units on a large scale.

Desires Beryllium Reprint

Editor:

Would like a reprint or photocopy of "If Beryllium Comes To Your Plant" Part I from your August, 1959 issue.

W. L. Gallagher
Project Engineer
B. D. Bohna & Co., Inc.
Consulting Engineers
San Francisco, Calif.

Article Helped Select System

Editor:

It may interest you to learn that I decided on using gas-fired absorption type air conditioning in my office (building) after reading the interesting article on same as employed in Reynolds Metals Building in Detroit.

Geo. T. Smith
President
Kleentab Co.
Austin, Texas

Requests Vacuum Cleaner Info

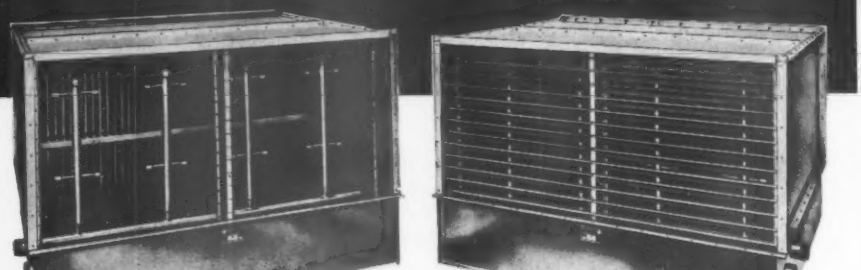
Editor:

In the May 16 issue of your excellent magazine, there was reference to a vacuum cleaner used in hospitals. Article stated that this particular vacuum cleaner was capable of removing 99.99 percent of airborne bacteria.

We are interested in obtaining one of these units. Please refer me to the manufacturer.

J. Murrow
Hazards Control Dep't.
University of California
Lawrence Radiation Laboratory
Livermore, Calif.

MASTER Air Washer



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A simple, self-contained unit that is easily installed. Requires a minimum of space and maintenance. Shipped ready to connect to ductwork, water supply, and drain.

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CAT. No. 160 *Rectangular spray washer with recirculating water ...practically unlimited in capacity*

BULLETIN No. FE10 *Cylindrical type . . . four standard sizes*

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C. H. Meyer
Product Engineer
The Trane Company
La Crosse, Wis.

Editor:

Let me congratulate you on a publication to cover a much needed facet of our industry, and a job tremendously well done.

W. W. Malloy
Malloy & Co.
Air Handling Equipment

Request For July Article

Editor:

In the July, 1959, issue of AIR ENGINEERING, an article, describing a low cost method of burning scrap insulated copper wire without creating smoke or odors was described.

In the City of Wilmington, Delaware, due to increasing complaints of this nature, ways and means of controlling this situation are being sought.

Would it be possible to get a copy of this article as an aid to a solution to this problem in our City?

Henry H. Wurtele
Ass't. Chief Fire Marshal
Fire Prevention Division
12th & King Streets
Wilmington, Deleware

July Manufacturer Errata

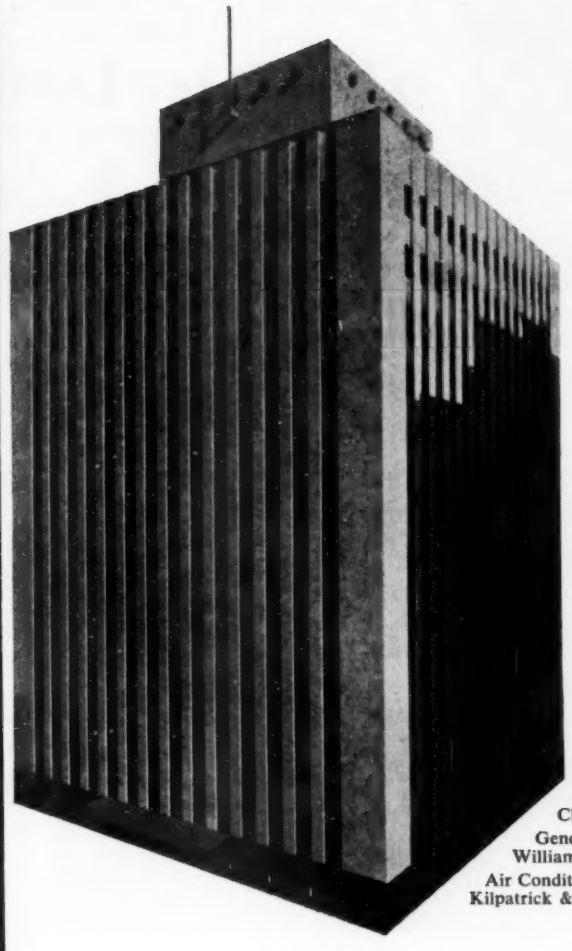
Editor:

Enclosed are half a dozen copies of our external house organ in which we quote from an article which appeared in the July issue of AIR ENGINEERING magazine.

In the article itself, we were disappointed to see the name of Blickman as fabricators of the screen and not ourselves as suppliers of the material which was described. We would sincerely appreciate it if you would just make a letter to the editor or some other similar note to rectify this omission.

Joel J. Shulman
Public Relations Manager
Pall Corp.

(Please turn to page 56)



Architects and
Consulting Engineers
Claud Beelman & Associates
General Contractor
William Simpson Company
Air Conditioning Contractor
Kilpatrick & Company

Los Angeles gets smog free building

Complete filtration of outside air brought into the new 550 South Flower Street Building in Los Angeles eliminates all odors and noxious pollutants.

Since "fresh air" seldom graces the Los Angeles area all incoming air passes through a bank of Barnebey-Cheney activated charcoal purification cells. Eighty-one cells purify 81,000 c.f.m. of air serving offices in the building. An additional 24 cells serve the basement and garage independently and 27 more handle outside air going to the sub-basement. Building users breath fresh, pure air any place in the building.

Write for Bulletin No. T-364 or give us the details of your application and we will supply specific data and samples.

Barnebey-Cheney, Columbus 19, Ohio.

activated charcoal air purification

Barnebey Cheney

NEWS of the Industry

Air Conditioning N.Y.'s Chase Manhattan Bank

The new $131-million Chase Manhattan Bank, said to be the sixth largest office building in the world, is soon to be built in the heart of downtown New York. The building's 64 stories will have nearly two million sq. ft. of floor space, 15,000 employees, and 10,000 visitors daily.

↑ *Data-Center at the world's sixth-largest building. Each Data-Center has two translucent screens which, at the touch of a button, show floor plans and schematic drawings for parts of the 64-story building. Here engineers make last-minute checks on one Data-Center before it leaves the plant.*

Fifty-one air handling systems will circulate two million cfm of temperature-controlled air day and night.

The anodized aluminum exterior will have 8,800 windows—a veritable window washer's paradise. Lights alone will give off 17 million Btu/hr. Peak heat will be over 275 million Btu.

The building is zoned at the 22nd floor for air conditioning purposes. The first 21 stories plus the five-story basement are on one system; a second air conditioning system serves the 22nd to 60th floors. Top four floors are filled with mechanical equipment.

There is a four-zone interior system on each floor, and these are supplemented by a perimeter system. Altogether some 3,000 thermostats are to be used.

Operating "brains" behind the air conditioning systems are two Honeywell "Selectographic Data-Centers," one on the 11th floor to handle the lower section, the other on the 31st floor to take care of the upper stories. These two Selectographics will enable two engineers to control comfort throughout the 64-story structure.

Farris To Produce Field-Proven Fuel Economizer

Farris Engineering Corp. has expanded its present facilities to mass produce a reportedly field-proven fuel economizer. The unit, Victor W. Farris claims, demonstrated its ability to save fuel and eliminate smoke during World War II when the Navy was faced with the problem of conserving on fuel and eliminating tell-tale smoke emissions.

According to Farris, the unit reduced fuel consumption by preheating intake air up to a temperature ranging from 400°F. to 875°F. before it contacted the boiler fire. By injecting a stream of preheated air over the fire, fuel and combustion gases were completely burned, eliminating smoke and waste.

Further, this clean and total burning of fuel also resulted in the elimination of practically all soot, carbon and sulphur deposits which had caused annoying maintenance problems. Farris added that the unit made possible a 25 per cent saving of fuel plus additional savings in maintenance expense.

The unit, requiring no fuel, power or maintenance, has no moving parts. It sells for $148.

Comfort Air Conditioning At Primary Defense Installation

The largest comfort air conditioning system, reportedly, west of the Mississippi has passed its first big heat test at one of the nation's primary defense installations—the R & D Facility of Thompson Ramo Wooldridge Inc. at Canoga Park, Calif.

By mid-summer of this year, temperatures hit 115°, but an air conditioning system of 2500 tons at present, and 5000 tons when fully developed, kept temperatures inside the vital 383,500 sq. ft. defense compound at 74°.

The Canoga Park facility is probing on such frontiers as electronic reconnaissance and countermeasures, microwave techniques, infrared systems, telemetry, nuclear devices, electronic language translation and advance radio and wireline communications. It is primarily engaged in research and development of complex electronic and aerospace systems.

The seven-building facility sits against the foothills on a 90-acre site. A central plant, built around a Recold fan-coil distribution system, was devised to furnish air conditioning on schedule and in volume to any part of the complex.

A spread of two 100 ft. x 200 ft. spray cooling ponds are used for heat rejection, instead of cooling

towers. The combined capacity of both ponds is 330,000 gallons of water. The spray pools dominate a mall at the upper level of the four-level terraced site. From each pool rise 120 one and one-half inch heads, bunched in 20 clusters of six heads each.

The condenser water system passes water through the heads to be sprayed in a mist into the air and cooled down to a range of 89°-94°.

Water is chilled to 40° by 12,400 lbs. of freon in two compressors. It is piped underground to the buildings, then returned at approximately 45° to be re-chilled after having done its work. Air passes over the coils in parallel, rather than in series, and enters the double-duct system to be distributed under medium pressure at 2400 fpm.

Central Heating & Conditioning

Anemostat diffusers at the point of distribution six, eight and ten inches, varying from 200 cfm to 400 cfm. The central heating and air conditioning units are housed in an 18,500 sq. ft. structure of tilt-up concrete. From this center, conditioned water flows to all units of the facility.

Each of the seven structures is serviced by six 35,000 cfm air handling units, putting total capacity at 1,470,000 cfm. Ten percent outside air is employed by the giant system, with the balance recirculated. Engineers, while challanged by the high and extended heat problems of the area, had no humidity problems per se. So no attempt was made to control humidity. However, controlled sound pressure levels are maintained throughout.

This giant plenum serves two Recold #580 Multi-zone units which supply one-third of the 210,000 cfm required for each main building at Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.

Doctor Has Strong Words On L. A.'s Smog Problem

Dr. Leon P. Belous recently contributed a letter to the Los Angeles *Times* commenting upon air pollution and the present status of control in that city. Among other important aspects mentioned, this item stands out:

"As for our precious babies in Los Angeles, they are facing the greatest danger of all. According to pediatricians I have spoken with, God gave babies a protective immunity in the first six months, and longer in some, to tide them over until they were strong enough to develop a resistance against colds, pneumonia and other respiratory diseases.

"Now the pediatricians find that the smog destroys that wonderful protective mechanism that nature gave infants. Now they have no protection whatsoever. The smog destroys that mechanism as soon as our babies arrive into our God-forsaken Los Angeles and start breathing the polluted air."

AEC AIR MONITORS

This battery of radiation monitors will sample air particles at the Atomic Energy Commission's nuclear power plant being built near Hallam, Nebraska. Developed and built by the Victoreen Instrument Co., 5806 Hough Ave., Cleveland, the units are part of a versatile monitoring system, considered the most complete ever produced. They were made under a contract awarded by Atomics International, a division of North American Aviation, Inc., which has designed the power reactor for the 75,000 kw electrical facility. Particles from the air drawn through the unit lodge on filter paper and are subjected to extremely sensitive measuring devices. Radioactivity levels are recorded by the unit and registered on a central control panel.

Researchers Release Data On Layer Inversion Effects

After three years of research, University of California radio engineers, Prof. W. D. Hershberger, assistant professor Richard C. Mackey and Dr. Warren L. Flock, have made public their findings on the effect of inversion layers on radio transmission.

Their findings show that when temperature inversion blankets a city, high frequency radio transmission from the ground to high-flying planes may be cut temporarily, as well as radio contact between two points in direct line of sight.

In 1956, the three engineers set up a transmitter on the 24th floor of the Los Angeles City Hall and a receiver on top of the UCLA physics building, establishing a microwave path 11.4 miles long.

Transmitting at 36,000 megacycles, they found that signals came in strong and clear on smogless days, but on days of temperature inversion, signals faded, often completely. The latter was especially true when the inversion layer was below 1,000 ft. and while the sun was rising.

British Dust-tight Standard

A report from England has it that, after many years of research on the possibility of evolving a British Standard for dust-tight electrical apparatus, a breakthrough has finally come about. Experts working with the British Standards Institute and the Electrical Research Assoc. have eliminated technical difficulties which once stood in the way.

Dust-tight enclosures are required to be suitable for use in dust laden atmospheres in which dust of any type may be encountered. It was therefore necessary to devise a method of testing the enclosures in which all dust was excluded.

Above: *Attending a full day symposium on super-clean atmospheres at Arizona State University, Tempe, were some 180 air engineers from the Southwest and the West Coast regions. Nearly every facet of White Room operations were covered in the papers given.*

A Report . . . White Room Symposium

Symposium on super clean atmospheres for dust sensitive equipment assembly draws plant executives from many industries.

by Eugene A. Sloane

A SYMPOSIUM on White Rooms, held at Arizona State University, Tempe, Arizona, on Nov. 1 drew some 180 air engineers from major industries in Southwest and West Coast States.

The group heard papers on White Room, or super-clean room design, by experts in design, operation and maintenance of these rooms.

Speakers at the one-day session were:

A. K. Baker, President, Baker Instruments, Inc., Chandler, Arizona, who spoke on Environmental Control.

Irving Kodel, Plant Engineer, Sandia Corp., Albuquerque, N. M., operating experience and use of the Projectina (a dust counting device using on optical microscope and projected image).

Dr. Alvin Lieberman, Research and Development Laboratories, Armour Research Foundation, Illinois Institute of Technology, Chicago, on Determination and Detection of Air Contaminants.

James R. Mildon, Corporate Plant Engineer, Lear, Inc., Grand Rapids, Mich., on his more than 20-years experience in the design and building of white rooms.

G. V. Freeman, Plant Engineer, Litton Industries, San Carlos, Calif., on design of white rooms for the microwave electronic tube manufacturing industry.

W. R. Jerome, Manufacturing Engineer, Autonetics Division, North American Aviation, Inc., Downey, Calif., on "A Philosophy Of Dust Control."

Edmund F. Casey, Senior Manufacturing Engineer, Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif. Problems of atmospheric contamination in production of liquid propulsion rocket engine systems.

R. Claude Marsh, physicist, Advanced Manufacturing Development Division, Sandia Corporation, Albuquerque, N. M., who spoke on "Dust Monitoring In The Super-Clean Room by The Dry Slide Settling Technique."

Eugene A. Sloane, editor, AIR ENGINEERING, spoke on "Communications In The White Room Industry."

The white room symposium was under the sponsorship of the Phoenix Chapter of the American Institute of Plant Engineers. Program chairman was Chris Gort, Plant Engineer, Sperry Phoenix Co., Phoenix.

New Association Formed

A by-product of the symposium was formation of a professional association specifically concerned with the design, operation and maintenance of white rooms,

(Please turn to page 21)

NEXT MONTH

AIR ENGINEERING

BRINGS YOU THESE FEATURED ARTICLES

- **MODERN TECHNIQUES FOR HEATING STEEL PLANTS**
  (Problems of getting heat down to floor level from high ceilings, ventilating for comfort in high radiant gain areas, are discussed. Technical data is broadly applicable since much of what's good air engineering for steel plants is good for a great many other factories.)

- **POWER AND ELECTRICAL REQUIREMENTS FOR ELECTROSTATIC PRECIPITATORS**
  (If you're considering an electrostatic precipitator to handle your dust collection problems, this article will help you figure your additional power requirements.)

- **VENTILATION IN THE CHEMICAL PROCESS INDUSTRY**
  (Here are sources of and exposures to personnel from gases, mists and vapors from plate and filter press operations in chemical plants, and how to design and build ventilation systems to handle these industrial airborne hazards.)

- **AIR CURTAINS IN FACTORIES . . . A CASE HISTORY**
  (Plant engineer at a General Electric plant tells how he used an air curtain to maintain relatively constant temperature in a manufacturing bay, eliminate cold drafts, provide door protection at a high traffic door opening.)

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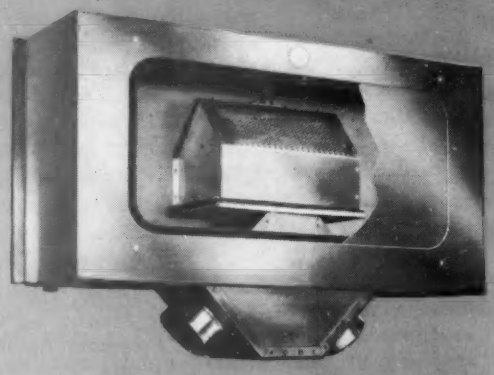

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Questions & ANSWERS

Data On Cancer Relative to Plastics

The June "Newsletter" (p. 12) contains an item which concerns cancer relative to certain plastics. Is this production processes only? Is there any danger in fabrication or processing operations with the plastic?

P.A.
Rochester, Minn.

Answer:

The experiments of Dr. Hueper [1], referred to in the Newsletter were done using the finished plastic or polymers in the physical form of powders, sheets, films and foam. The experiments were not conducted on the toxicity or carcinogenic properties of the raw materials, and intermediate materials involved in the processing.

The experiments of Dr. W. C. Hueper indicate that certain cancers and sarcomas have been produced in a highly susceptible to cancer animal, the rat. From these experiments it cannot be definitely concluded that the cancer producing properties of these plastics will product cancer in humans.

At the present time there is no record of cancers being produced in humans by polyethylene, polyurethane, or polysilicones; although certain of the plastics namely: polyethylene [2] have been used for a number of years as cartilage and bone substitutes, plastic lung prosthesis, arterial reinforcement and hernia repairs with no adverse effects from being implanted in the human body [2].

Polysilicones have been used in protective skin creams, sun tan lotions, needles, syringes, and treatment of paper for food preparations with no adverse effects. Polyurethanes are manufactured from a class of materials called diisocyanates (toluene, methylene bis, paraphenylene) diisocyanates. These materials are extremely toxic and produce a serious asthmatic type of reaction in concentrations as low as 0.01 parts per a million.

The finished plastic or polymers however, are physiologically inert; the monomer may however cause irritation to the skin.

It is believed that in the light of the present experience of the polymers in question (polyethylene, polysilicone, and polyurethane) in human exposures that these materials have not been proved to be highly dangerous carcinogenic materials. The experiments with the rats indicate the materials should be viewed with suspicion as having potential significance to human carcinogenesis.

REFERENCES

(1) Hueper, W. C., M.D., *Carcinogenic Studies on Water Insoluble Polymers. Industrial Hygiene* Abstracts American Industrial Hygiene Assoc. 1960.

(2) Wilson, Rex H., M.D., McCormack, William E., *Plastics, Vol. 21, No. 6,* June, 1960.

Cleaning Small Air Ducts

Would like to know how to clean a sooty dust from air ducts too small and concealed for entrance.

Answer:

The cleaning of ducts in which dust laden air is handled is not an uncommon practice. In fact, most well designed systems for handling dust such as foundry dust systems, grinding wheel systems, etc. are installed with clean-out openings in the ducts for easy access. These clean-out openings vary in design from a simple cut out hole in the duct closed by a bolted split sleeve connection, to a more elaborate opening such as hinged duct doors.

Good design for location of cleanout openings is at not more than 10 ft duct intervals. If there is any portion of the duct that is not concealed, clean out openings should be located at these points. If the duct is totally concealed cleaning must be done through hood, grill, or fan connection openings.

The cleaning can be done with brushes on a steel cable, or by blowing with a compressed air nozzle to loosen up the dust, or by the use of a commercial vacuum cleaner. Cleaning is often done when using brushes or compressed air nozzles with the ventilating fan on. The dust loosened by brushing or compressed air is carried away through the duct and discharged to the dust collector or outdoors. Sooty, greasy deposits can be loosened by brushing with high flash naphtha, or by use of low flammability commercial solvents.

White Room Symposium . . .

(Continued from page 16)

super-clean rooms, contamination control and allied problems.

The new association, now in process of formation, will be known as the American Society For Control of Contaminated Areas (ASCCA).

It is planned to include as members in the new association engineers who design super-clean areas, engineers who operate and maintain them, and application engineers of manufacturers who furnish white room components and supplies.

First order of business, once the ASCCA is organized, will be to set up an engineering committee, with sub-committees covering basic phases of white room or super-clean room engineering. These committees will set up standards, design criteria, pass on products and components, and assist in setting up research projects for ultra-fine dust control.

An ad interim executive committee has been set up to handle details of organizing the new association. This committee will be dissolved in favor of elected officers when the Association has been organized.

Members of the executive committee include: Arthur Baker, President, Baker Instruments, Inc., chairman; Irving Kodel, Sandia Corp., Albuquerque, N. M.; James Mildon, Corporate Plant Engineer, Lear, Inc., Grand Rapids, and others to be selected by Mr. Baker.

While Association emphasis will at first be on problems of contamination control in industry, the need for hospital air sanitation, particularly in operating rooms, and the special needs of bacteria and dust control in the pharmaceutical industry, are recognized and will be within the scope of the ASCCA.

AIR ENGINEERING was selected by the ad interim executive committee to publish technical information and papers emanating from the ASCCA.

As a starter, AIR ENGINEERING will publish the papers given at the Tempe, Arizona White Room Symposium, over the next few months.

White Room Symposium Papers Available as Preprints

A complete set of preprints of the papers given at the Tempe, Ariz. White Room Symposium is available at $5.00 per set.

A few quotations from the papers given at this meeting will highlight the topics covered.

Irving Kodel said: "The science of the white room is new. It is related to air pollution, air conditioning, industrial hygiene, but it has a distinct character of its own."

Mr. Mildon: "I think the most important thing, if nothing else comes out of this meeting, is the possibility of having a permanent association to accumulate information which we who work with white room problems so sorely need. Twenty years ago I built my first 'white room' . . . it was dust-free provided you could avoid stumbling over the clinkers in it. Today we have a different concept of white rooms. We need to know, however, just how clean a white room should be, how clean is clean?"

Mr. Claude Marsh, who gave a paper jointly prepared by himself, Mr. Kodel and Willis J. Whitefield, physicist, Advanced Manufacturing Development Division, Sandia Corp., "In the art of manufacturing, the clean room is simply another tool for producing a better end product. As in any manufacturing operation, it is necessary not only to control certain conditions, but to monitor these conditions to establish whether or not they are being realized."

Ed Casey: "As Rocketdyne looks ahead at more sophisticated propellants and at nuclear conversion systems, the indications are that we are only getting started. The end or a breakthrough, signifying a change in the trend, is not in sight. Components for space ships, space stations and planetary colonies, which many of us will undoubtedly be manufacturing in the next decade, will have a reliability far in excess of today's accepted quality levels. Reliability is basically dependent upon two parameters: (1) adequate designs and (2) elimination of tangible sources of failure. Contamination is one source of failure which can and must be controlled."

W. R. Jerome: "Dust control is a problem that concerns everyone from the housewife with her dust-cloth to the laboratory technician with his microscope. It is an ever present and in this age of miniaturization, an ever increasing factor of precision assembly.

"Autonetics designed and built the Mark II inertial navigation system that is installed in the nuclear submarine George Washington, the same type of system that guided the Nautilus and Skate on their historic voyages under the ice cap of the North Pole, voyages of 1800 nautical miles traveling for four days and nights completely submerged. This type of blind navigation calls for the finest of precision instruments . . . instruments with manufacturing tolerances of ten-millionths of an inch. This precision . . . and cleanliness . . . of the inertial guidance system on these nuclear subs, is typical of the type of precision required in nearly all of the other product lines of Autonetics."

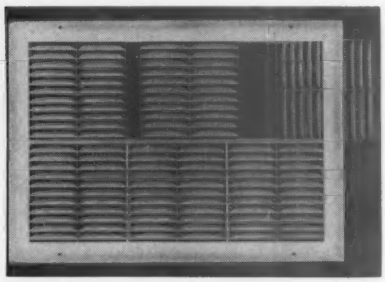
Mr. Freeman: "It is obvious that there cannot be a single plan or design that will give a solution to

(Please turn to page 52)

Below: *By-product of the White Room Symposium are plans for a professional association. Known as the American Society for Control of Contaminated Areas, the association will soon be a reality. Shown planning the new group are, left to right: Edmund Casey (at head of table), plant engineer, Rocketdyne Div., North American Aviation, Inc.; Wm. Jerome, plant engineer, Autonetics Div., North American Aviation; G. V. Freeman, plant engineer, Litton Industries; Arthur Baker, president, Baker Instruments, Inc.; E. A. Sloane, editor, AIR ENGINEERING, and Don Cravener, Reynolds Aluminum Corp.*

New PRODUCTS

Modular Return Air Grilles



Purpose: To allow total free area of approximately 75 percent based on core area.

Features: Claimed to be unbreakable, non-corrosive, non-combustible. One piece vanes set at 30° angle, allowing for aforementioned free area. In grilles larger than six sq. in., the modules are mounted in aluminum mullion channels, permitting build-up in six inch increments, in sizes up to 36 in. x 24 in.

The entire assembly is contained in a specially designed extruded aluminum "contour" frame assuring rigidity in large sizes.

Source: Air Guide Plastics Corp., Dept. AE, 20 S. E. 3rd Ave., Miami 32, Florida.

Air Duct Calculator

Purpose: To provide duct sizing by the Equal-Friction or Velocity-Reduction Method, as well as estimating metal and insulation requirements.

Features: Works on slide rule principle. Any or all of the following data may be read with one setting: friction per 100 ft. of duct; cfm; velocity-fpm; round duct diameter in inches, and rectangular equivalents in inches; weights per lineal ft. of round duct in pounds for the various gauges of galvanized and aluminum duct; and surface area in sq. ft. per lineal foot of round duct.

Also, by setting width plus depth of rectangular duct at an arrow, the weight in pounds per lineal foot may be found opposite the various gauges of galvanized and aluminum duct, as well as the surface area in sq. ft. per lineal foot. Size 4 in. x 8½ in. Price: $2.50.

Source: Paul S. Morton Engineering Service, 5131 Meadowlark Lane, Kalamazoo, Michigan.

Visual Schedule Control

Purpose: A visual control for maintenance operations, with changeable magnetic devices, said to save time and increase industry efficiency.

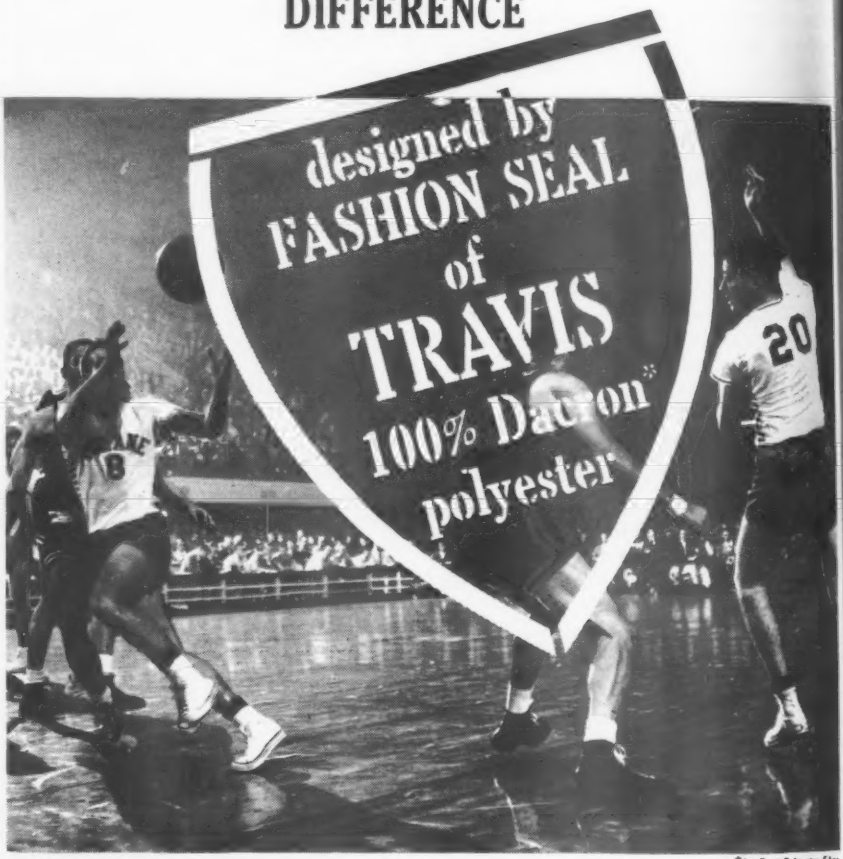
Features: Can be used for scheduling of maintenance personnel and/or maintenance work; renovation planning for big buildings; preventive maintenance control of machines; service schedules; location control of utility work crews on city maps, etc.

Consists of a magnetic steel board which holds firmly on its surface the visual elements that comprise the needs of the user.

Source: Methods Research Corp., 105 Willow Ave., Staten Island 5, New York.

(Please turn to page 24)

TEAMWORK MAKES THE DIFFERENCE



*Du Pont Polyester Fiber

There is no better symbol of teamwork than this emblem. It represents years of coordinated research between the textile engineers of Travis Fabrics and those of Fashion Seal Uniforms in a mutual effort to attain the ultimate in white room apparel.

In the fabric development phase of the program, cloth made from every synthetic and natural fiber possibly adaptable for our purpose was tested. Results have clearly indicated the specially constructed 100% Dacron polyester to be the finest fabric woven for white room use.

• Lint-Free • Anti-Static Finish • Comfortable
• Extremely Durable • Launders Easily

For further information on white room apparel, write:

TRAVIS FABRICS INC., 1071 SIXTH AVENUE, NEW YORK 18, N.Y.

PAYING MORE FOR STEAK...OR DUST?

MIKRO-PULSAIRE MODEL 20-6

If your present dust control system is not delivering maximum efficiency, unchecked waste dust may be costing you more, on a pound for pound basis, than the finest cut of steak. Nuisance dust is a mighty expensive item when you consider its damaging effect on equipment, on employee morale, on general plant appearance and community relations. The most practical and economical solution of any nuisance dust problem is the MIKRO-PULSAIRE Collector, now available in new flexible modular units designed to meet any required capacity however large or small . . . attested recovery efficiency 99.9% plus . . . absolutely no moving parts, internally or in the gas stream . . . 4 or 5 times the capacity of conventional bag houses per unit of cloth area. For the toughest dust collection jobs – call on our engineering staff, and the MIKRO-PULSAIRE. Ask for Bulletin 52A-1.

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REPRESENTATIVES throughout the United States, Continental Europe, British Isles, Canada, Mexico, Central and South America, West Indies, South Africa, India, Japan, Philippines, Australia and New Zealand.
MANUFACTURING FACILITIES: United States, Canada, Continental Europe, British Isles.

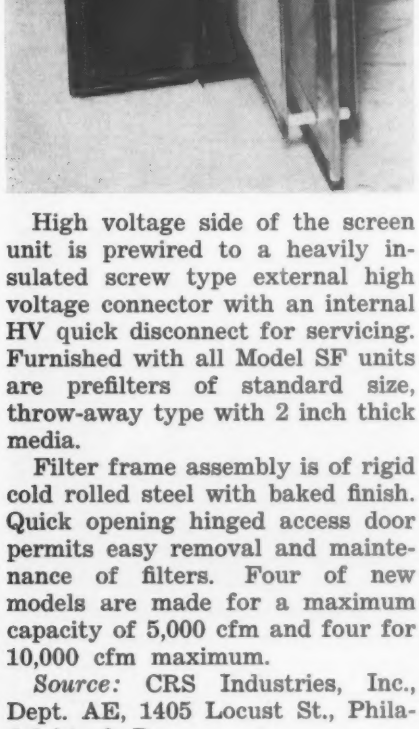
New PRODUCTS

Statronic Screen Unit

Purpose: Introduction of eight new screens for use in the Statronic System of dirt and dust control.

Features: Made of heavy gauge metal, all welded framing with reinforced corners. Sheet metal enclosure and access door is made of heavy gauge sheet steel with baked blue industrial finish. Screens are framed with rolled edges to prevent flutter and distortion.

Screens are constructed of heavy galvanized interwoven wire mesh. Nylon buttons on slide-out assembly provide easy removal. As a safety feature, factory-wired safety switch de-energizes and grounds all parts of the Statronic System when the access door is opened.



High voltage side of the screen unit is prewired to a heavily insulated screw type external high voltage connector with an internal HV quick disconnect for servicing. Furnished with all Model SF units are prefilters of standard size, throw-away type with 2 inch thick media.

Filter frame assembly is of rigid cold rolled steel with baked finish. Quick opening hinged access door permits easy removal and maintenance of filters. Four of new models are made for a maximum capacity of 5,000 cfm and four for 10,000 cfm maximum.

Source: CRS Industries, Inc., Dept. AE, 1405 Locust St., Philadelphia 2, Pa.

Dew Point Transducer

Purpose: To measure dew points in Fahrenheit ranges from -20 to +60.

Features: Suited for outlet measurement of endothermic gas generators used in controlled atmosphere heat treating.

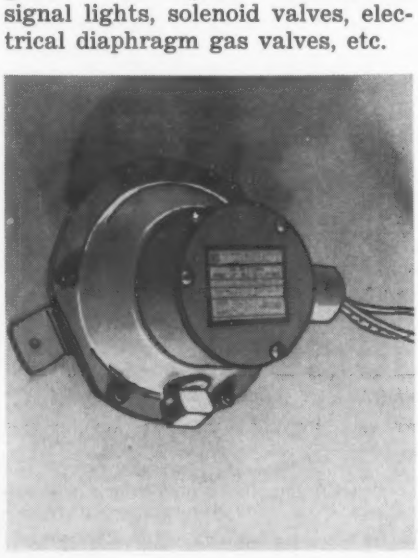
Manufacturer reports that desirable continuous monitoring of dew point is achieved by establishing a continuous flow of gas through the transducer. A millivolt output provides a choice of indicating, recording, controlling or alarm read-outs.

No moving parts. Minimum operation attention required. Platinum resistance thermometer elements said to be interchangeable. Zener reference diode provides close voltage regulation.

Source: Alnor Instrument Co., Dept. AE, 420 N. LaSalle St., Chicago 10.

Low Pressure Switch

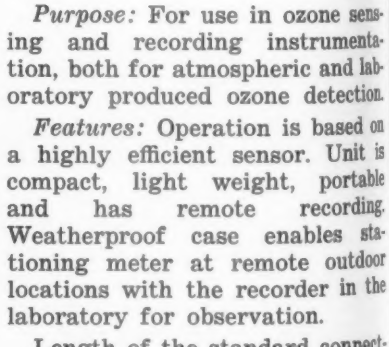
Purpose: To provide a low pressure cut-off and alarm safety shut-off, differential pressure or vacuum controller for air or non-hazardous gases. Will operate alarms or signal lights, solenoid valves, electrical diaphragm gas valves, etc.



Features: Switch is responsive to pressure as low as 0.25 in. w.g. with on-off switch differential of 0.1 in. w.g. when switch is supplied with a range of 2 in. w.g. Switch may be used as vacuum or differential control if vacuum or low pressure connection is connected to air or inert gases.

Pressure connection is for air or inert gases, but on special order can be supplied for use with liquids, water, or gases. Suited for commercial, industrial, and military applications. The pressure settings are said to be readily adjustable in the field by means of an adjusting screw. Reportedly, a maximum pressure of 40 in. w.g. can be applied to the switch without damage. Switch is approximately 5 in. diameter and 4 in. deep; supplied in ranges of 2 in., 4 in., 8 in., and 20 in. w.g. Weight: 1½ lbs.

Source: The Henry G. Dietz Co., Inc., Dept. AE, 12-16 Astoria Blvd., Long Island City 2, New York.



Ozone Recorder

Purpose: For use in ozone sensing and recording instrumentation, both for atmospheric and laboratory produced ozone detection.

Features: Operation is based on a highly efficient sensor. Unit is compact, light weight, portable and has remote recording. Weatherproof case enables stationing meter at remote outdoor locations with the recorder in the laboratory for observation.

Length of the standard connecting cable is 30 ft. Remote positioning of the meter at distances up to ¼ mile from the recorder is possible by extending the connecting cable. Operating range: 0 to 100 pphm/volume; sensitivity: ± 2 percent of full scale; sampling rate: approximately 140 cc/min.; response time: 75 percent

of true value in one minute; unattended operating time: about three days.

Source: Mast Development Co., Inc., Dept. AE-11, Davenport, Iowa. Model 725-3B.

Filter Vacuum

Purpose: To provide safe collection and handling of radioactive and toxic dusts.

Features: Heart of unit is a filter of special design to permit easy removal and replacement in order to control the hazard of recontamination during filter changeover. Manufacturer states that filter has gained wide acceptance in industry for the collection of last traces of toxic and radioactive dusts from industrial processes.

Each filter is tested for a minimum efficiency of 99.97 percent on particle sizes of 0.3 microns. A special gasket flange provides a tight air and dust seal for the cylindrical filter. Collection tank has recoverable capacity of 1⅔ bushels of dry material. Unit also suitable for modified wet pickup.

Source: Cambridge Filter Corp., Dept. AE-11, 738 East Erie Blvd., Syracuse 1, N.Y.

Marine Ventilating Fans

Purpose: Designed for use in the marine industry.

Features: Fans claimed by manufacturer to meet installation requirements for mounting on deck, ceiling, and bulkhead as stipulated by U.S. Maritime Administration. Available in three basic types: centrifugal, vane axial,

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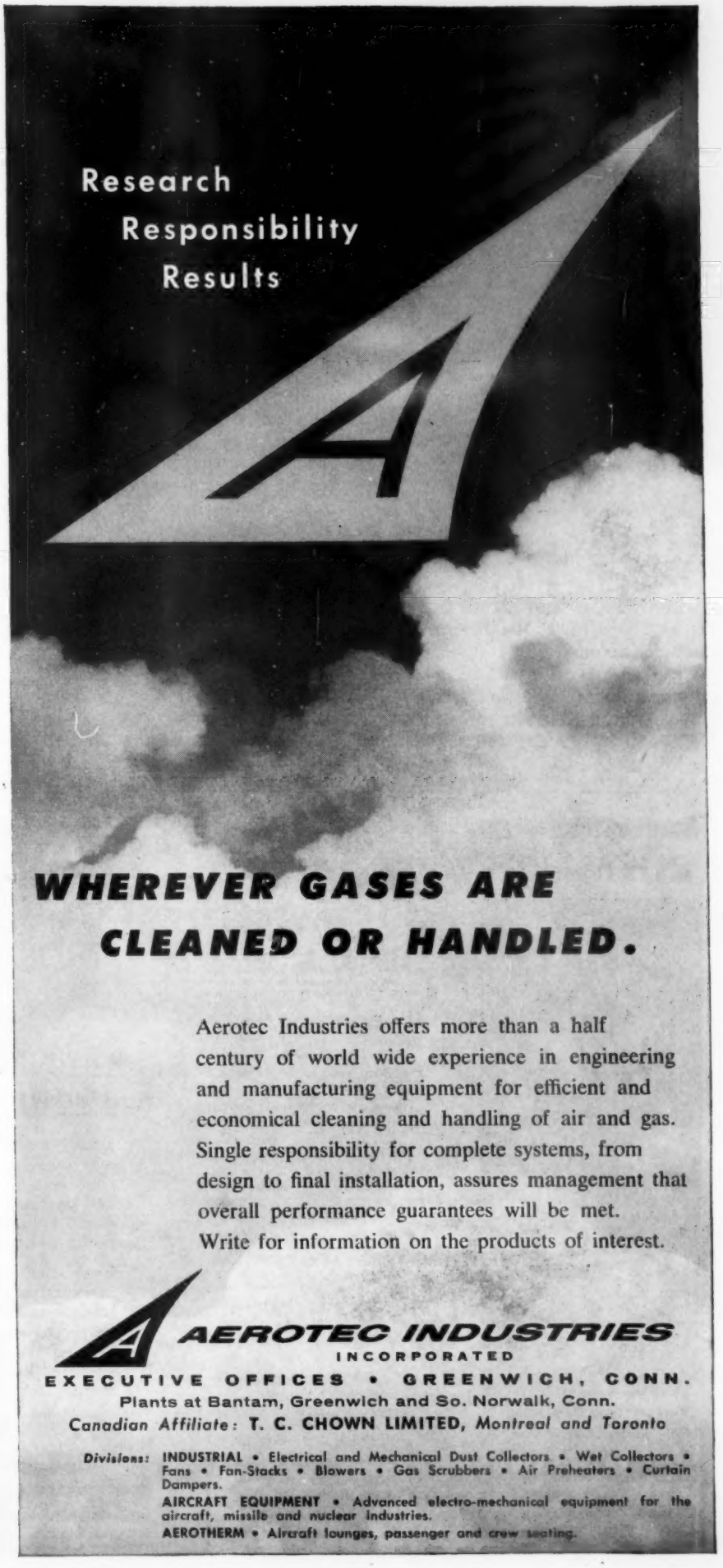
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Responsibility
Results
WHEREVER GASES ARE
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Aerotec Industries offers more than a half century of world wide experience in engineering and manufacturing equipment for efficient and economical cleaning and handling of air and gas. Single responsibility for complete systems, from design to final installation, assures management that overall performance guarantees will be met. Write for information on the products of interest.
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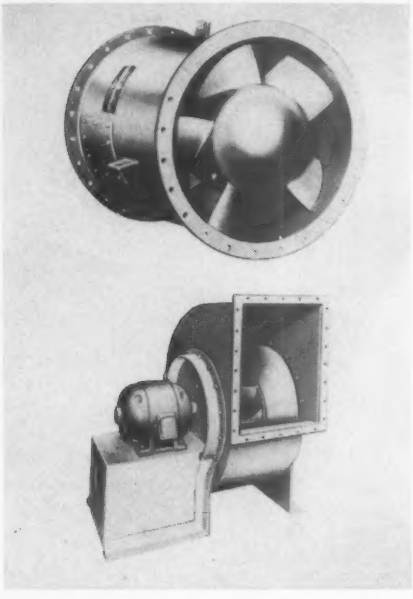
Divisions: INDUSTRIAL • Electrical and Mechanical Dust Collectors • Wet Collectors • Fans • Fan-Stacks • Blowers • Gas Scrubbers • Air Preheaters • Curtain Dampers.
AIRCRAFT EQUIPMENT • Advanced electro-mechanical equipment for the aircraft, missile and nuclear industries.
AEROTHERM • Aircraft lounges, passenger and crew seating.

(Continued from preceding page)

and centrifugal airfoil mechanical draft fans.



Centrifugal fan capacities run from 250 cfm to 10,000 cfm, with fan sizes from 2.5 to 100. Standard units employ direct drive from motors, with belt drives also available. Motor sizes range from 1/20 hp. to 5 hp. Axial fan capacities from 1000 cfm to 40,000 cfm, with fan sizes ranging from 10 to 400, and motor sizes ranging from ½ to 20 hp.

Airfoil mechanical draft fan capacities as high as 1,097,940 cfm, with fan sizes from 24½ to 80¾.

Source: Chicago Blower Corp., Dept. AE, Marine Division, 9867 Pacific Ave., Franklin Park, Ill.

New Line Centrifugal Fans

Purpose: For incorporating into apparatus or installations requiring ventilation or movement of air.

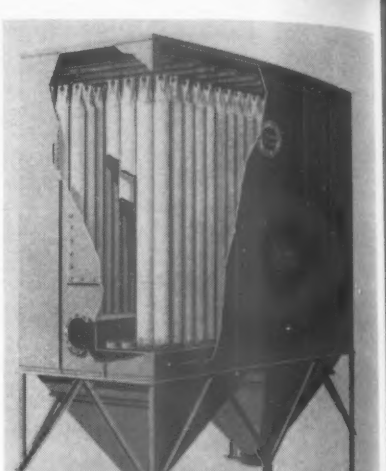
Features: Fan has housing which can be rotated to change the angle of air discharge. Balanced steel fan is directly connected to the permanently lubricated motor to assure highly efficient, quiet operation with minimum maintenance.

Source: Ilg Electric Ventilating Co., Dept. AE-11, 2850 N. Pulaski Rd., Chicago 41, Ill. Model 6S.

Fabric Filter

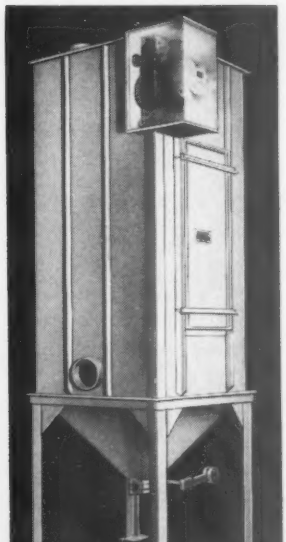
Purpose: For the collecting of industrial dusts.

Features: Available in two size ranges: the fabric envelope type for low gas volume applications, and a tubular type for dust collection of high gas volumes. The envelopes and tubes come in a broad range of fabrics including orlon, nylon, dacron, and glass. Fabric is cleaned by a shaker mechanism or reverse gas flow.



Source: John Wood Co., Dept. AE, Air Pollution Control Division, Bernardsville, New Jersey, Bulletin No. 150.

RUEMELIN *Dust Control* EQUIPMENT



Vacuum Type Dust Filter with Electric Bag Shaker.

Ruemelin Dust Filters achieve a high rate of efficiency in the control of fine dusts. Our tubular bag design provides —

- Low resistance to air flow.
- Thorough shaking of bags while fan is shut down. Eliminates tautness.
- Maintenance, inspection and replacement of tubes made easy by our patented design.

Ruemelin Dust Filters collect and suppress dust created from all types of industrial applications. Available in single compartment or continuous multi-compartment units in capacities from 500 to 30,000 CFM.

Over 3000 collectors in service. Write for bulletin 24-D.

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Illustrates instruments and gages...*diagrams* their installation and on-the-job use... *charts* valuable performance data.

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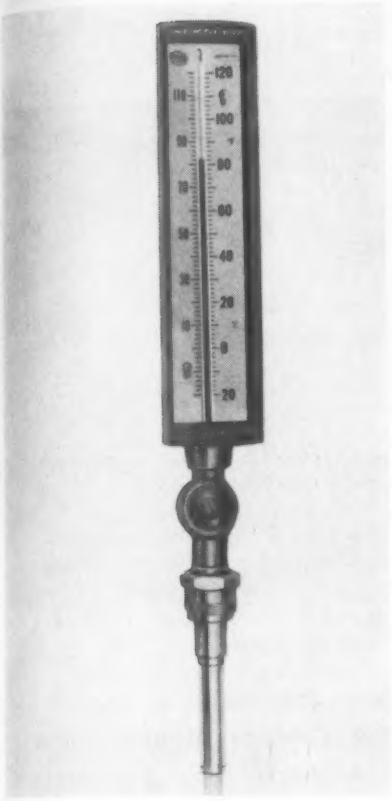


"Adjust-All" Thermometer

Purpose: To provide flexibility of application.

Features: The patented instrument combines three adjustment features to permit 360° change of angle on the case and stem, plus variation of stem length. All adjustments can be made in the field. Totally enclosed die cast hinge assembly.

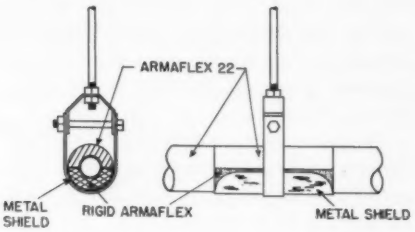
Source: Weksler Instrument Corp., Dept. AE, Freeport, New York.

Rigid Plastic Load-Bearing Insulation

Purpose: To be used as a load bearing insulation at pipe hanger locations, deeply buried underground lines and other areas where pipe covering may be subject to compression set deformation.

Features: Developed to be used in conjunction with manufacturer's line of flexible foamed plastic pipe covering. Available in nominal ½ in. and ¾ in. thicknesses for sizes ⅜ in. I.D. to 3 in. I.P.S. and is furnished in pre-matched half sections three feet long.

Can be used from below Zero to 220°F. and its closed cellular structure is said to give it a low *k* value of 0.28 at 75° mean temperature. Claimed to resist moisture and deterioration, so thermal efficiency remains high in service. Self-extinguishing and ozone resistant.



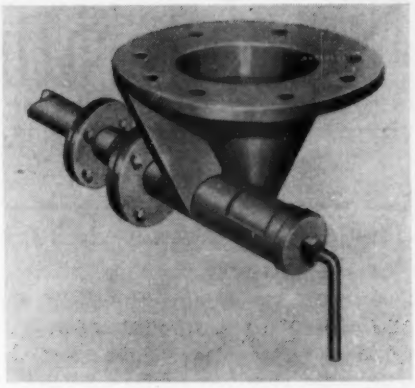
Source: Armstrong Cork Co., Dept. AE, Lancaster, Pennsylvania.

Sani-Mop Vac System

Purpose: To provide a compact and automatic system for cleaning and removing dust and lint from dry mops, dusters, dust cloths, etc.

Features: There are only a half-dozen component parts to the system. These include a slotted plate, flush mounted on the floor or on top of a cabinet, the Hoffman multistage centrifugal exhauster, Smooth Flow tubing and a wet or dry separator, depending on the application.

An inlet valve also permits the unit's use for vacuum cleaning with stationary systems.

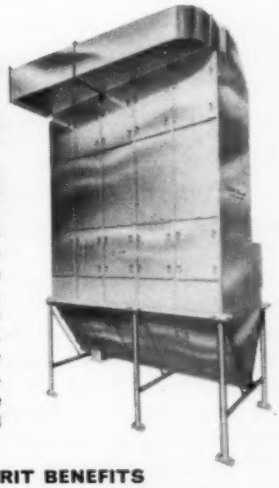


Source: U.S. Hoffman Machinery Corp., Dept. RN (AE), Air Appliance Division, 103 Fourth Ave., New York 3.

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, new products, new items, etc.

If you wish to contact manufacturers directly, street addresses are given. But please mention you saw it in AIR ENGINEERING.

NEW TORIT DUST COLLECTOR IS AUTOMATIC!



Save real dollars with the benefits from this automatic dust collector. No more interruptions on production lines! Maintenance problems are practically eliminated. This all new continuously cycling TORIT dust collector automatically cleans your air and automatically shakes its own filters and blows them clean with reverse air flow. Collected material is emptied automatically.

OTHER EXCLUSIVE TORIT BENEFITS

- automatic filter-shaker mechanism is simple, maintenance-free
- different dusts may be collected separately
- highest air-to-cloth ratios (from 5 to 25:1) and longer filter life
- only ¾ H.P. required for fully automatic operation
- polished 3/16" aluminum construction for minimum floor loading
- modular design—5' wide x 4'-8" long (for two sections) x 15'-6" high—saves space, lends ease and versatility to installation. Use up to 12 modular sections for each application! No limit to CFM capacity!

Write today for literature.

TORIT MANUFACTURING COMPANY
Automatic Collector Division
1133 Rankin Street, St. Paul 16, Minnesota, Dept. 1935

New Literature

Books

The Chemical Analysis of Air Pollutants

● An intelligent approach to the control of air pollution in industrial hygiene and public health programs is given in this authoritative collection of air analysis methods, written by Morris B. Jacobs. Sampling procedures, methods for soot and dust analysis, smoke, auto exhaust, radioactive substances and other pollutants are given in detail. Illustrated, 488 pages. Price: $13.50.

Source: *Interscience Publishers, Inc., Dept. AE-12., 250 Fifth Ave., New York 1.*

Engineers' Handbook

● A vestpocket-size handbook listing valuable information on math, building, mechanics, heat, hydraulics, piping, electricity, surveying, costs, mining, and chemistry. Liberally illustrated with charts, graphs and formulas. 192 pages. Price: $1.

Source: *Ottenheimer Publishers, Inc., Dept. AE-12., Baltimore, Maryland.*

Reports

Technical Progress Report

● Prepared by the Los Angeles Air Pollution Control District, this is volume one (Control of Stationary Sources) of a four volume series. Chapters include: *Boilers and Heaters, Metallurgical Industry, Mineral Processing Industries, Incineration, Petroleum Industry, Organic Solvents, Other Industrial Sources, Air Pollution Controls for Aerosols,* and *Air Pollution Controls for Gases and Vapors.*

Source: *Air Pollution Control District, Dept. AE-12, 434 S. San Pedro St., Los Angeles 13.*

Air Pollution In Charleston, South Carolina

● "The purpose of this appraisal was to determine the status of the air pollution situation, and the need for government activity in solving [Charleston's] air pollution problems." Contains informative data, charts, maps and aerial photographs; each contributing to a clear picture of air pollution problems in a leading Southern city.

Source: *The Robert A. Taft Sanitary Engineering Center, Dept. AE-12., Cincinnati, Ohio.* Technical Report A60-6.

Bi-State Chicago Metro Air Pollution Study

● The report presents a compilation of existing 1957-59 air pollution data pertaining to an area comprised of five counties in Illinois and one county in Indiana which the report denotes as the Chicago Metropolitan Area. Charts, maps, 148 pages.

Source: *Illinois Department of Public Health, Springfield.*

Catalogs

Methods for Microscopic Particle Sizing (Manual 6)

● Publication describes methods of determining particle sizes by using optical or electron microscopes, oil immersion techniques for particle mounting, and use of eyepiece graticule for sizing and counting.

Proper particle measurement methods also are discussed as well as the equation for converting particle size by count to particle size by weight.

Source: *Gelman Instrument Co., Dept. AE-12., 106 Main St., Chelsea, Michigan.*

Sutorbilt "California" Bulletin

● The 12-page bulletin describes and illustrates the manufacturer's series of rotary positive blowers. Complete dimensional information on all models and sizes is given by means of charts and drawings. Two-color bulletin also lists two pages of performance data for low pressure, medium and high pressure units.

Source: *Sutorbilt Corp., Dept. AE-12., 2966 E. Victoria St., Compton, Calif.*

Hartzell Industrial Ventilation Bulletin

● Gives data on manufacturer's complete line of equipment for use in corrosive atmospheres, with details on all-fiberglass duct fans.

Source: *Hartzell Propeller Fan Co., Dept. AE-12, Piqua, Ohio.* Bulletin 1117.

Centrifugal Airfoil Bladed Fan Bulletin

● Describes manufacturer's line and lists suggested applications. Outline type installation drawings are provided to convey basic dimensional data for all sizes and arrangements. Dimensions for fans equipped with inlet vanes are also presented. 60 pages.

Source: *American-Standard Industrial Div., Dept. AE-12, Detroit 32.* Bulletin A-1103.

Beta-Ray Gauges for Gas-Density Measurements

● Engineering data are presented for Beta-ray gauges or other electron probes working on the attenuation principle for measuring gas densities. The relations, ranges and attenuation coefficients for Beta-sources are shown by graph. 19 pages, eight figures, including engineering graph (20" x 30"). Price: $2.50.

Source: *Ontario Research Foundation, Dept. AE-12, 43 Queen's Park Cres. Toronto, Ont., Canada.*

Airfan Standard Blowers

● A 26-page catalog listing manufacturer's product, with performance and dimensional data, as well as charts, photographs and illustrations. Contains information on models with four-way discharge, twin assemblies, triple assemblies, utility sets (enclosed drive) and cabinet blowers.

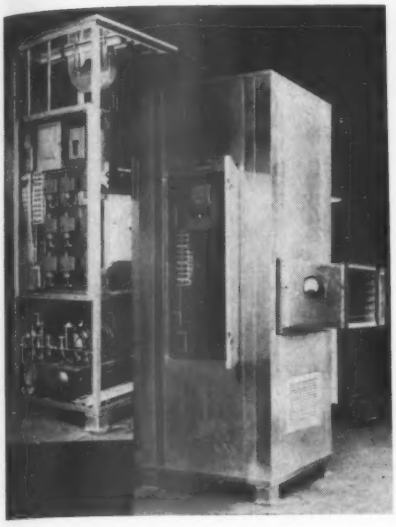
Source: *Airfan Engineering Co., Dept. AE-12, 7401 Telegraph Rd., Los Angeles 22.* Catalog STD-60.

Heat Transfer Catalog

● The 32-page release covers manufacturer's complete line of radiators, heat exchangers, supercharger air coolers, industrial and oil field equipment and heating and air conditioning products. Information includes brief company history, an illustrated description of location, facilities and services.

Source: *Young Radiator Co., Dept. AE-12, Racine, Wis.,* Catalog No. 160.

New PRODUCT OF THE MONTH . . . .



AIR CONDITIONING UNITS made especially for use in white room or "super-clean" areas is the December selection for the *New Product of the Month.*

These units are designed for continuous operation, are pretested at factory, and require only connection to source of power and drain. Tonnage ratings are in the 2 to 7½ ton range.

Compressor/condenser sections are of the unloading type and operate continuously without icing. Evaporator blower and coil section dehumidifies and cools, also operating continuously. Reheat can be by electric, hot water, or low-pressure steam coil, depending upon utilities available.

Dust control is accomplished by disposable CWS filters which have found wide acceptance for clean room use. Filter plenum, with specially designed access hatch, is included in package. Ductwork schematics and detail drawings for fabrication of ductwork at job site are furnished.

Configuration of units is of three basic types: vertical, for mounting on floor adjacent to clean room; horizontal, for mounting on platform over clean room; and, split type, where heat rejecting equipment is mounted remote from clean room and in which pre-fabricated refrigerant lines with quick-connect type fittings are furnished to avoid costly pumping up.

Performance Warranty

Manufacturer claims these advantages: guaranteed leaving air conditions, faster delivery of equipment, lower initial cost and lower maintenance cost.

Heat load questionnaire used for calculating required size of unit is available in check list form without charge.

Further information may be had by writing to: *Packaged Laboratories Division, Agnew-Higgins Inc., Dept. AE-12, 380 East Green St., Pasadena, Calif.*

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of AIR ENGINEERING.

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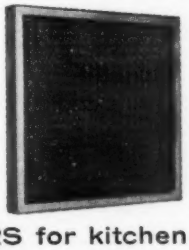

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Unique Air Conditioning System At GE Jet Plant

Above: *This huge General Electric Flight Propulsion Div. plant makes jet engines, employs 14,000 people, has six-and-one-half million sq. ft. of floor space.*

Central plant, packaged units, evap cooling used with unusual plenum ceiling arrangement, for office comfort cooling.

by C. F. Mowrey*
Project Engineer, General Electric Co., Flight Propulsion Division

NEED OF INCREASED modern office capacity in one of the large manufacturing buildings at the Evandale, Ohio plant of General Electric Co., called for careful analysis in order to affect maximum practical utilization of available facilities, such as chilled water capacity, packaged air conditioning units, fan rooms, piping, controls, plenums, etc., while adequately meeting design requirements totalling 700 tons of air conditioning.

Final requirements called for indoor design of 77° dry bulb at 50 percent relative humidity, or the effective temperature equivalent, while providing 25 percent outside air at 95° dry bulb and 78° wet bulb. Additional requirements called for good regulation of zone conditions, adaptability to rearrangement and expansion of offices and to installation of the system in stages. Naturally, simplicity and reasonable owning and operating costs are highly desirable.

The general area involved is approximately 665 ft. x 400 ft., including offices, fan rooms, specialized equipment, etc. The following relates only to two similar adjacent office areas, each with approximately 80,000 sq. ft. net, undivided except by low level partitions. A number of private offices and conference rooms with ceiling high partitions are located around the perimeters of these areas, but these offices are already air conditioned according to their particular requirements. The schematic sketch, Fig. 1, shows present and future stages (eliminating for the sake of clarity details not pertinent to the description).

The final stage of completion of the two 80,000 sq. ft. areas called for improved lighting and suspended acoustical ceilings. By this time, each area will have been divided into four areas averaging 20,000 sq. ft. each by ceiling high block walls. Past experience indicated that the addition of separate offices within or adjacent to the open areas could be anticipated.

A description of these areas and the facilities available at the start of modernization planning is as follows:

Part of the air conditioning was supplied by chilled water coils in fan rooms, from whence the air was blown into plenums on two sides of each area, then into these areas through wall diffusers. The balance of cooling was supplied by 10-ton packaged air conditioners located throughout these areas and operating 100 percent recirculating. Inasmuch as the

concrete ceiling is 14½ ft. high, the distribution from the packaged units was quite effective.

This system was quite satisfactory in meeting the requirements for which it was originally designed, but could not meet the greatly expanded and more exacting needs involving personnel, lighting, and zone control, regardless of partition changes.

Design for Stage Installation

The final design provides for installation in stages and at convenient periods of time.

It was apparent that the increased capacity required during maximum design conditions could be obtained by the use of an increased amount of chilled water from the central plant. Consequently, additional coils were installed in the fan rooms supplying plenums, and supply ducts were extended throughout the entire area.

The plenum air is distributed by four-way diffusers, preceded by opposed blade dampers and air scoop deflectors to insure proper distribution. The 10-ton packaged air conditioners were left in the same locations as previously; however, remote thermostats were installed to improve control of the zone temperatures.

It was planned that in the zones adjacent to the plenums all cooling would come from the duct system supplied by the plenums and that the thermostats for controlling the plenum air temperatures to all zones would be located in these few zones.

The plenum air distribution to the remaining areas containing packaged air conditioning would be only ⅔ as much per sq. ft. Consequently the packaged air conditioners would make up the difference and thus effect zone control without reheat or volume control. With a 14½ ft. ceiling, and with duct diffusers at an average height of 11 ft., good distribution and mixing with the air from the packaged units did not present a problem. Also, this system could be workable either before or after the installation of the walls which would later divide the 80,000 sq. ft. net areas into four smaller areas.

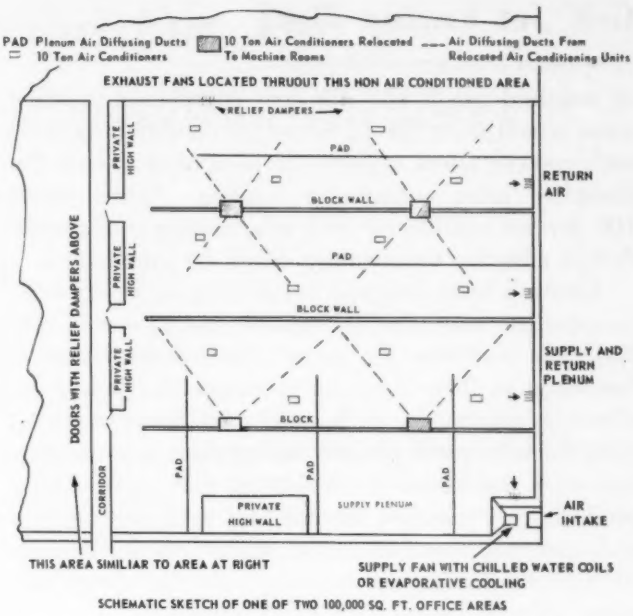
PAD Plenum Air Diffusing Ducts
10 Ton Air Conditioners
10 Ton Air Conditioners Relocated To Machine Rooms
Air Diffusing Ducts From Relocated Air Conditioning Units
EXHAUST FANS LOCATED THRUOUT THIS NON AIR CONDITIONED AREA
RELIEF DAMPERS
PAD
BLOCK WALL
PRIVATE HIGH WALL
RETURN AIR
SUPPLY AND RETURN PLENUM
BLOCK
DOORS WITH RELIEF DAMPERS ABOVE
CORRIDOR
PRIVATE HIGH WALL
SUPPLY PLENUM
AIR INTAKE
THIS AREA SIMILIAR TO AREA AT RIGHT
SUPPLY FAN WITH CHILLED WATER COILS OR EVAPORATIVE COOLING
SCHEMATIC SKETCH OF ONE OF TWO 100,000 SQ. FT. OFFICE AREAS

Fig. 1: *Schematic sketch of one of the two 100,000 sq. ft. office areas for which author designed air conditioning system. Supply plenum noted at bottom of drawing runs along wall at bottom of drawing.*

Unusual Problem—Unusual Solutions

Although chilled water from the central plant could handle ⅔ of the load during the summer, this system was so integrated with the factory heating system that it was economically very impractical to operate it for cooling during the factory heating season. This situation would have left the cooling system shy by 200 to 300 tons at times in the late spring and early fall.

It was decided to bridge this gap with evaporative cooling. Although evaporative cooling would be a decidedly poorer method for aiding office air conditioning in a summer climate, with an outside design of 78° wet bulb, it was a natural for this particular application for several reasons.

Outdoor wet bulb design during the short periods

(Please turn to following page)

Mr. Mowrey is a registered professional engineer with over thirty years experience in the design and installation of air conditioning, including systems involving various processing, testing and production problems. He is acting as consultant in this field with the General Electric Flight Propulsion Division.

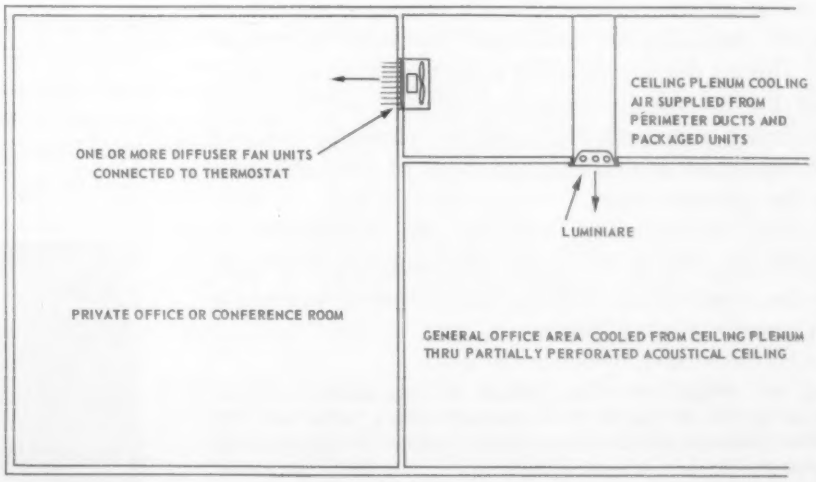
ONE OR MORE DIFFUSER FAN UNITS CONNECTED TO THERMOSTAT
CEILING PLENUM COOLING AIR SUPPLIED FROM PERIMETER DUCTS AND PACKAGED UNITS
LUMINIARE
PRIVATE OFFICE OR CONFERENCE ROOM
GENERAL OFFICE AREA COOLED FROM CEILING PLENUM THRU PARTIALLY PERFORATED ACOUSTICAL CEILING

Fig. 2: *Simple method of providing very adequate air conditioning to ceiling-high diffusers.*

G-E Jet Engine Plant

(Continued from preceding page)

of required use is 65°; the low latent load in office areas would leave the packaged air conditioning units with reserve latent capacity to somewhat reduce the humidity after evaporative cooling. While using 100 percent outside air with evaporative cooling, the design effective temperature could be maintained.

Controls were designed to call for a lower dry bulb temperature when the evaporative cooling was in use, and thus maintain the same effective temperature. Inasmuch as there were no processes that would be adversely affected by the humidity and lower temperatures for infrequent periods during short seasons, savings were considerable, considering that sprayed coils produce very effective evaporation with low owning and operating costs. In actual practice the air flowing through the coils, and utilizing only the spray was often reduced between 17 to 21 degrees.

The air conditioning system, as described above, was completed as the first stage, and when customary minor adjustments were made, operated very satisfactorily.

During the time the system was being installed, the improved lighting was added at a height of ten feet in such a manner it will be a simple matter to install the acoustical ceiling by utilizing the lighting fixture supports. This will create an approved ceiling plenum which can be used as described later.

The second stage, consisting of the erection of the ceiling high block dividing walls, was done during the vacation season, thus minimizing interference with normal procedures. The only system change required was a relocation of two air conditioning units that were in the way of the proposed walls. The third stage will be construction of the small machine rooms; relocation of the package air conditioning units into these rooms; extension of simple ducts with diffusers from each unit and wiring from each unit to a central panel to indicate the zone temperatures and control the packaged units.

Control System

The control will provide for turning the units on or off manually, or in several categories by timers.

The air ducts, extending from the units, will reach just far enough for general mixing of air from the packaged units with that from the plenums, and will be equipped with the same type of side diffusers, as the plenum ducts.

The fourth stage will be the installation of acoustical ceiling, of which approximately 4 percent of the area will be sufficiently perforated to provide for complete air diffusion.

Fig. 3: ***Chilled air from plenum at top, mixes with air from packaged units (not shown). Eventually air will come through acoustical ceiling, supported by lighting fixtures.***

This space between the suspended ceiling and a concrete ceiling (from 10 feet to 14½ ft. above the floor) meets plenum requirements. It will contain all air diffusers from the plenum ducts and the air conditioners. Consequently, very fine air distribution will be achieved by utilizing one of the various standard types of air diffusing ceilings. It will also allow great flexibility, since diffusing sections may be rearranged to meet the changed office requirements.

Air Conditioning for New Private Offices Readily Available

With this system of air conditioning, private offices can be constructed within the general area or at the perimeters, and be very easily air conditioned. If the walls extended only to the acoustical ceiling, it would be a simple matter to arrange the perforated sections in the ceiling for proper distribution in reference to direction and volume.

If the walls extended to the upper ceiling, the volume and distribution could be handled very satisfactorily by several methods of properly introducing the correct amount of air for any type of load up to heavy conferences. For example: by installing one or more partition fans actuated by a thermostat.

To date, integration of existing facilities has been very effective. Some of the minor utilizations not so apparent are as follows: The five inch chilled water lines supplying two of the fan rooms were not large enough to supply the additional coils. Booster pumps were a much more economical solution than the construction of new pipe lines. A supply plenum 7 ft. wide and 14½ ft. high was made into a supply plenum and a return plenum by installation of a simple steel deck covered with insulation installed horizontally 7 ft. above the floor level; many relief dampers and the general exhaust system on the same floor fitted into the design without alterations.

Among the miscellaneous items of interest are: smoke detectors in the air streams arranged to shut down fans at a certain smoke density; pneumatic general air conditioning control system; general air filtering done by large sheets of 2-in. thick viscous impingement disposable material in the fan rooms and the same 2-in. material in smaller sheets in the packaged air conditioning units. Filtering for various processes in adjacent areas is specified according to particular requirements.

The control sequence has produced very com-

(Please turn to page 60)

Air Cleaning For The Secondary Smelting Industry

Secondary smelting operations pose some tough air pollution problems. Here are solutions.

Fig. 1: *A furnace designed so maximum amount of heat reaches charge rather than dissipating to atmosphere.*

by Donald J. Blum,
Joseph K. Blum
Consulting Engineers
New York City

THE PROBLEMS of controlling air pollution from metal reclaimers or secondary smelters are varied and complicated. Combustion problems of all types are encountered, including production of alternate reducing and oxidizing atmospheres, afterburning, low temperatures, exceedingly high temperatures, incineration and the collection of metallic fume.

Some reclamation processes require procedures that promote the production of airborne particulate matter. Others are carried out at temperatures below those necessary for good combustion. A satisfactory air pollution control program must always be planned so production is not interfered with.

Secondary non-ferrous smelters reclaim copper, tin, lead, antimony, aluminum, zinc, etc. from almost any condition in which it has been discarded. Old brass pipe, automobile radiators, used pots and pans, plumbing valves, pencil ferrules, used wire, printing plates, gas meters and many other items contain non-ferrous metals which are separated either by hand, machine, heat or other processes. There is almost no consistency of raw materials, and operations change from day to day.

What are some of the problems of secondary non-ferrous smelters and metal reclaimers? Why are unusual control programs instituted? What problems face the ferrous metal reclaimers? In this article we shall discuss specific programs we have set up for a few of the many types of reclamation procedures that are used in industry.

The separation of combustible material from non-combustible metals has received a great deal of attention lately, particularly from law enforcement officials. Burning rubber, etc. from automobile bodies and burning of insulation from copper and aluminum wire are particularly important to all in the scrap business. Presently these processes are carried out in open bonfires, with resultant production of large volumes of black and acrid smoke. This is a very satisfactory operation for the reclaimer because he merely throws gasoline or kerosene on the scrap late in the day and by the next morning the scrap is cool and ready for baling. There is little handling required and almost no investment in equipment. The smoke produced at night goes unnoticed by most people except the neighbors.

Some Special Considerations

Several types of incinerators have been developed to handle this work which require considerable investment. A large hurdle to overcome in a control program is to recognize that open burning must be abolished and that car burning and wire reclaiming must be done in an incinerator or separator. The metal reclaimer can no longer operate without equipment of some kind. (For data on smokeless car burning, see p. 48, April 1959 issue).

Copper in wire is highly refined and commands a premium price if it can be separated from its insulation without contamination with other materials. (See article on wire burning on p. 24, July, 1959 issue). If possible, heavy cable is stripped mechanically by the use of cutters which produces the most valuable copper. If the wire is small, the insulation is burned. The lower the combustion temperature during this operation the more valuable the copper will be. Herein is the problem. Low temperature combustion produces smoke and can produce noxious gases. The resultant smoke then must be collected or reheated and burned in an after burner.

Many wire incinerators have been built recently, but few have achieved economic success, primarily because of overheating of the copper or lack of achievement of stable burning conditions. In batch burning, where say 1000 lbs. of insulated wire is ignited, and where one quarter by weight is combustible insulation, 250 lbs. of insulation such as rubber, polyethelene or vinyl may be ignited and started burning at once. Large amounts of air must be added to control the smoke. By careful design and draft control, temperature and combustion can be controlled and smoke can be eliminated.

Because copper when overheated combines with other material metallurgically and loses its purity, we have found that a controlled burning rate is necessary to avoid excessive temperatures of the copper, and that reheat and subsequent burning of the smoke is necessary to eliminate the noxi-

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ous gases. One manufacturer of electronic precipitators claims to be able to collect the smoke from wire burning. Another has developed an afterburning process which has been approved by air pollution control boards.

Automobile burning, done on a much larger scale, presents almost no problems of metal overheating and subsequent reduction of the value of the metal reclaimed. Therefore slow rates of combustion are not necessary. The problem involves only the ability to achieve proper combustion temperatures exceeding about 1200°F.

Not all our experiments in designing furnaces for burning insulation from copper wire have been successful. One experiment involved the use of over-fire air jets. The jets did reduce smoke but increased the temperature of the burning wire to a point far exceeding the melting point of copper. When the batch was finished the copper had lost a great deal of value. Efforts to seal the openings into the incinerator firing chamber resulted in extreme coking of the insulation which did not then easily separate from the wire. Ash separation from the wire is usually done by hand.

Batch burning of wire insulation probably will continue to be the method used in the industry until a suitable method of moving the tangled mass of scrap wire is developed. Automobile bodies, however, can rather easily be handled continuously on a conveyor. In continuous burning, combustion is easier to control. Air-fuel ratios remain almost constant and afterburning of smoke or collection present little difficulty.

Melting of scrap metal to form ingots is usually done either in a reverberatory or a rotary furnace. In both, scrap is charged in batches into the furnace and allowed to come in direct contact with the flame. The charge is melted and runs under the slag cover. Then by the addition of certain chemical fluxes or heat, impurities are oxidized and/or combined with chemicals into the slag. The metal is poured into ingots, and the slag is skimmed.

Fume in form of oxides can be emitted in large quantities, particularly when melting yellow brass. We have found that this can be controlled by controlling the atmosphere, improving or changing the flux or using collectors.

High Temperature Problems

As in the case of smoke, the place to control emission from a furnace is in the furnace. However in some refining operations, this is impractical, and the resulting fume must be handled outside the furnace by the use of collectors, baghouses, scrubbers etc. There are many problems in handling these high temperature dust laden gases. In setting up a control program it is more economical to reduce emissions before resorting to collection devices.

In general, the less fuel that is used, the smaller the quantity of gas generated, and, consequently, the lower the velocity of gas flowing over the melt. Lower velocity gas picks up fewer solid particles. It follows too that the furnace must be designed so that the maximum possible amount of heat reaches the charge rather than being dissipated to the atmosphere. Improvements in heating efficiency of existing equipment is worthwhile.

The control of the atmosphere in a furnace requires constant vigilance on the part of the operator as well as adequate and reliable equipment. The oil or gas burner should be equipped with a good means of controlling the fuel air ratio and the proper conditions of draft or pressure should be maintained. I know of furnace installations where the air and fuel control valves get so hot while the furnace is in operation, that it is impossible to control the air-fuel ratios. As a furnace heats, conditions of burning change, requiring constant adjustment. Even if the best equipment is provided, the results will not be good if the furnace operator is inexperienced.

It is beyond the scope of this article to discuss the desirability of maintaining a particular furnace condition, i.e., oxidizing, reducing, or neutral atmosphere to obtain the best metallurgical results. The decision as to the kind of atmosphere best suited for a

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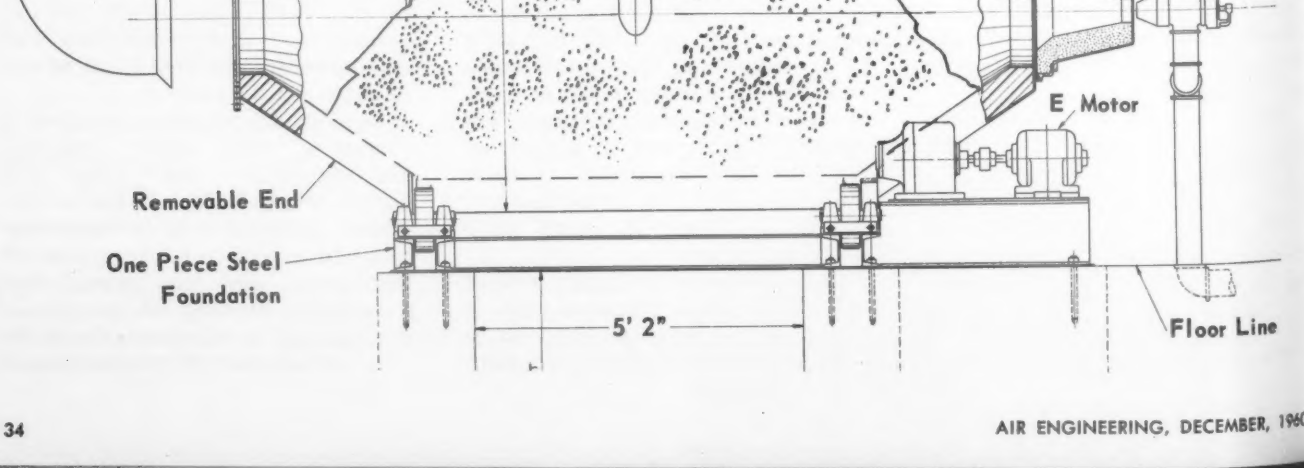
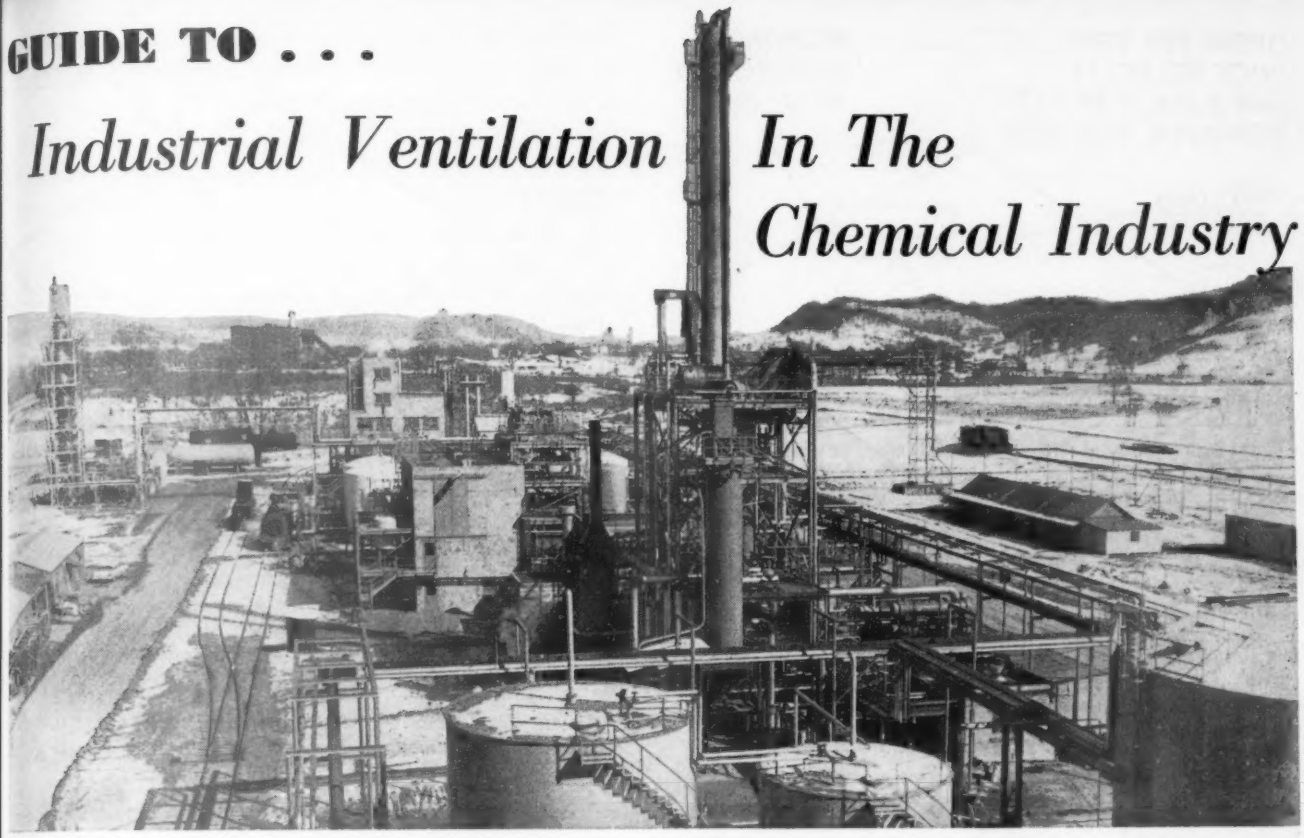
Fig. 2: *By addition of certain chemical fluxes or heat, impurities are oxidized and/or combined with chemicals into slag, in reverbatory furnaces such as this.*



GUIDE TO . . .

Industrial Ventilation In The Chemical Industry



View of American Cyanamid Co.'s new aniline manufacturing facilities at Willow Island, W. Va. Plants such as these require careful design of ventilating systems to maintain employee health.

By William V. Andresen
Chief Industrial Hygienist
American Cyanamid Co.

For problems of controlling air vented from bins, weigh hoppers or similar equipment, here is a discussion of solutions with open tee or navy hood.

THE NAVY HOOD and open tee types of ventilation may be used in the chemical industry where relatively small exhaust air volumes are required to control dusts, gases, mists and vapors evolved from chemical process equipment. They are also used where it is desirable to maintain a slight negative pressure on process equipment to prevent the escape of toxic or irritating vapors. It may be desirable to exhaust as small a volume as possible to minimize product loss in some instances; in other cases where equipment is relatively tight, it may be possible to exhaust only a few cfm.

It is not practical to design ductwork small enough to exhaust these small air volumes and at the same time maintain a satisfactory duct velocity, without incurring excessive pressure loss in the ductwork. The navy hood, or open tee, which draws a portion of exhaust air from the workroom will allow the design of ductwork without excessive pressure drop and the maintenance of a satisfactory transport velocity. Duct blockage is less likely to occur in these designs than if small, tightly connected ducts are used.

The navy hood or the open tee may be used to control the air vented from bins, weigh hoppers or similar equipment to which solids are charged. Usually the volume of air displaced from the bin by the material charged into it is of small volume, a few cfm. Many of the available references recommended that a volume of ½ - 1 cfm per cubic foot of bin volume be exhausted from the bin to maintain an indraft on the bin by the direct connection of a duct to the bin.

For small bins, the recommended exhaust volume is small and necessitates the design of ductwork of

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***WILLIAM ANDRESEN** is chief industrial hygienist for the American Cyanamid Co. A graduate engineer, he is vice chairman of the Bergen County, New Jersey air pollution control committee. He is also a delegate from the National Safety Council to the American Standards Association committee Z-9 on industrial ventilation. He is a member of the American Industrial Hygiene Association.*

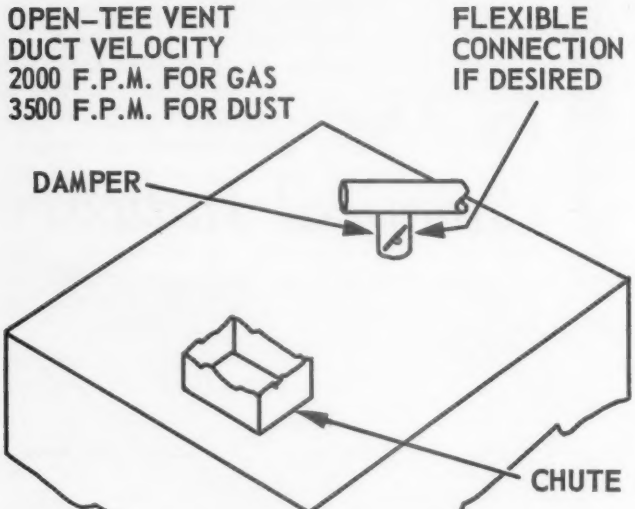


Fig. 1: *An open tee design as used to control air vented from bins. A damper may be installed in the open branch of the tee for volume adjustment purposes if bin is not completely tight.*

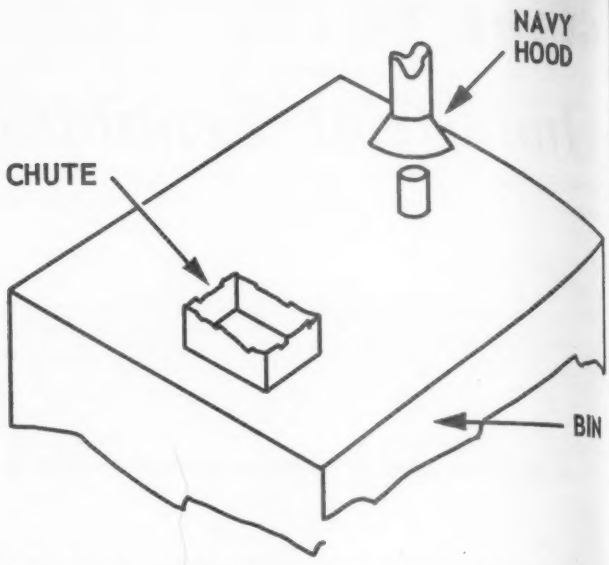


Fig. 2: *A navy hood type of design as used to control air vented from bins. The positioning of the navy hood with respect to the bin vent will regulate air volume vented from the bin.*

Chemical Ventilation . . .

(Continued from preceding page)

extremely small diameter which results in large pressure drops. For larger bins, the recommended exhaust volume may be considerably larger than the volume displaced by the material charged to the bin. If the bin is not tight and air can enter through openings in the bin, it may be possible to exhaust this volume. However, if the bin is tight, the calculated exhaust volume cannot be exhausted and duct blockage may occur unless special openings are provided in the bin for air entry. From a production viewpoint, it is desirable to operate with tight equipment.

Figs. 1 and 2 show navy hood and open tee designs as used to control the air vented from bins. A damper may be installed in the open branch of the tee for volume adjustment purposes if the bin is not completely tight. The positioning of the navy hood with respect to the bin vent will regulate the air volume vented from the bin.

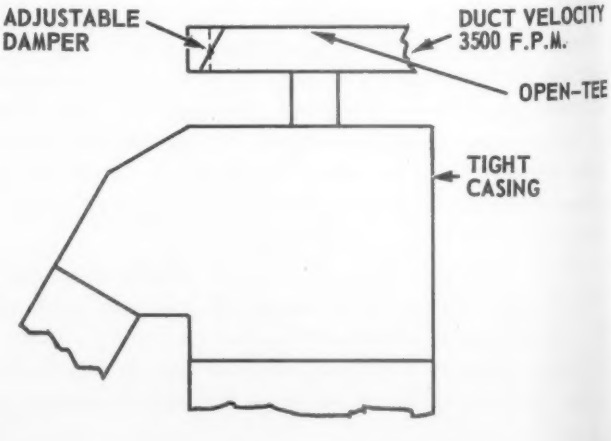
Bucket Elevator Operations

The open tee and navy hood can also be used to provide control in bucket elevator operations. Various references recommend that an exhaust volume equivalent to 100 cfm per square foot of elevator casing cross section be used to provide an indraft on the elevator casing. It is only possible to exhaust an air volume of this magnitude if the elevator casing is not tight and/or if the charge and discharge points of the elevator are open and air can be drawn in through these openings. It is often desirable in chemical processing to operate in a closed system and to maintain tight equipment. It is also desirable to maintain a slight indraft on bucket elevators as many of the chemicals conveyed in the equipment are extremely toxic or irritating.

Figs. 3 and 4 show the application of the navy hood and open-tee to maintain an indraft on a bucket elevator and at the same time maintain transport velocity in the ventilation system ductwork.

Fig. 3 shows an open tee connection with one branch of the tee connected to the elevator and the other equipped with a damper and open to the room. With the damper in open position, the major portion of the exhaust air volume is drawn from the room and at the same time the elevator casing is kept under negative pressure. As the damper is

Fig. 3: *Here shown is the application of an open-tee to maintain an indraft on a bucket elevator and at the same time maintain transport velocity in the ventilation system ductwork.*



partially closed, more air is exhausted from the housing to maintain an indraft. When the damper is completely closed, all control air will be exhausted from the elevator. This type of installation provides flexibility and air flows can be adjusted to suit varying conditions.

Fig. 4 shows an adjustable navy hood which operates in a manner similar to the open tee. The closer the hood is located to the conveyor housing vent, the more air is exhausted from the housing. At the same time, transport velocity is maintained in the ductwork. Usually an exhaust volume of 100-300 cfm will provide the desired control for either the navy hood or the open tee.

A manifold type of open tee ventilation may be applied to provide control of gases, dusts, mists and vapors from two or more pieces of chemical equipment which require relatively small control air volumes. Fig. 5 shows an example of the open tee in a manifold system. Added system flexibility may be realized by the utilization of a gravity damper in the open section of the tee. The gravity damper may be so balanced that when a piece of equipment is opened, the majority of the control air will be available at that piece of equipment.

The navy type hood may be used for final adjustment of control air volumes exhausted from process equipment. It may be desirable for process yield purposes to exhaust the absolute minimum air volume required to control gases, dusts, mists or vapors evolved. By positioning the navy hood with respect to a duct or vent on the equipment, this may be realized without effecting duct transport velocities or overall exhaust system balance. The open tee may also be used for this purpose by providing a damper in the section of the tee attached to the process equipment. The damper may be adjusted to exhaust the minimum air volume required for control from the equipment without affecting the duct transport velocity.

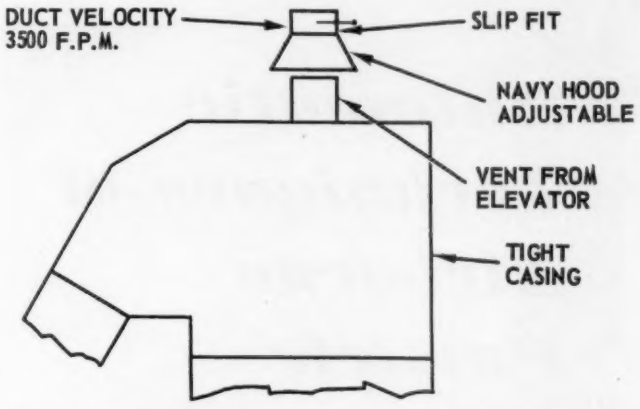


Fig. 4: ***An adjustable navy hood which operates in a manner similar to the open tee. The closer the hood is located to conveyor housing vent, the more air is exhausted from housing.***

The navy hood or open tee may be used for many other chemical process ventilation applications.

One example is the ventilation enclosed of flakers or filters in which chemical materials which are toxic or irritating in extremely low concentrations are processed. The ventilation in such cases is applied to maintain a slight negative pressure on the enclosure. A large exhaust volume might result in loss of yield. With the navy hood or open tee, the negative pressure on the enclosure may be easily adjusted to the minimum required to prevent the escape of the toxic or irritating material. The navy hood or open tee may also be used to provide ventilation control of ribbon type blenders which are difficult to seal. ▲▲

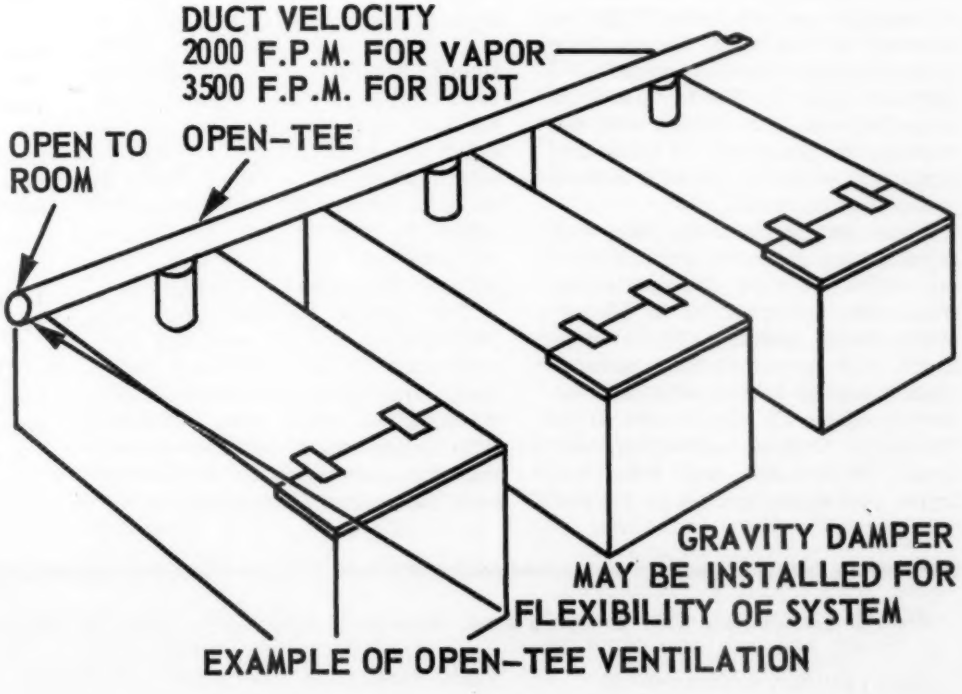


Fig. 5: *This is an example of an open tee in a manifold system. Added system flexibility is achieved by utilization of a gravity damper in the open section of the tee.*

Automatic Techniques of Airborne Particle Counting

Here's a special report from Armour Research Foundation on airborne particle size and concentration in white room areas, as recorded by automatic particle counter.

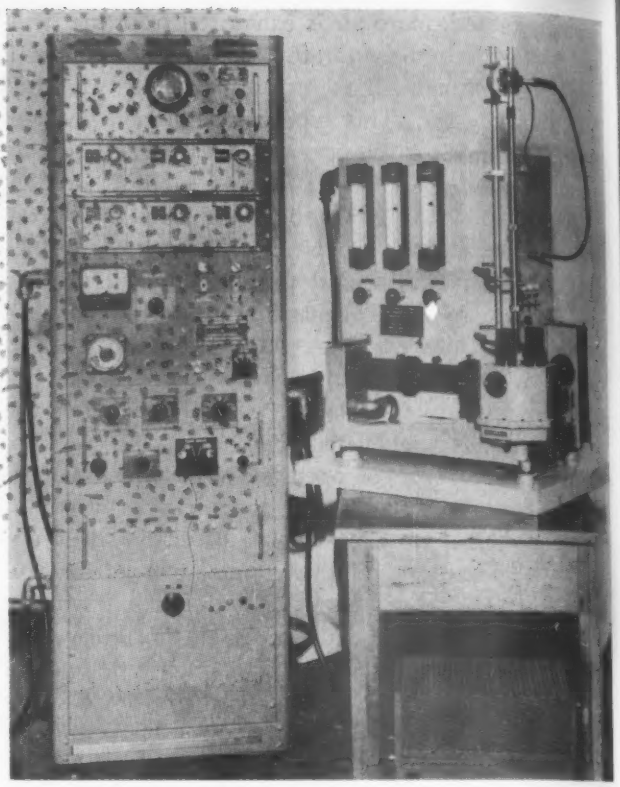


Fig. 1: *ARF particle counter. Small cabinet houses aerosol-handling, optical systems, photomultiplier with preamplifier; large cabinet; electronic and readout systems.*

THE CONCENTRATION and size distribution of airborne particles in a newly completed ultraclean precision assembly area were examined with an automatic particle counter utilizing light scattering as a means of detection. The range of particle sizes and the concentrations were related to the amount of activity in the area. With no activity in the area the particle concentration varied around 100 particles/liter.* These particles were between 0.5 micron and 4.0 microns in diameter. The concentration of particles above 1 micron was about 10/liter.

With six people inspecting and repackaging parts the particle concentration rose to 314 particles/liter with particles up to 16 microns being present. There were about 120 particles/liter greater than 1 micron in diameter. The recovery time of the room from simulated normal operation was about 20 minutes and from extreme contamination about 1 hour.

As indicated in the above summary, the ultraclean room has become an essential tool for the precision instrument manufacturer. Elaborate and expensive ultraclean facilities are being provided in which to assemble and test precision parts. Recent articles [1,2] attest to the increasing interest in such facilities. Little is known of the actual dust levels in these rooms, however, and nothing has been published which relates particle size and concentration in the assembly environment to instrument failure. As a result, there is no assurance that the measures taken to protect the assemblies are adequate or, conversely, that they do not exceed requirements.

This article presents quantitative data on particle size and concentration in an ultraclean room under simulated operations conditions. These data were obtained with an automatic particle counter and size discriminator, which has some interesting applications for monitoring clean rooms. It immediately provides data on the dust level in the most useful form—particle diameter and concentration. The instrument not only makes it possible to study particle size and concentration, but also to determine their effects on instrument reliability.

As an example of the type of data supplied by the automatic particle counter, typical dust levels found in urban and rural air and in a modern machine shop are shown in Table I. These data provide an interesting comparison with the ultraclean room data given later.

Description of the Automatic Particle Counter

The Armour Research Foundation (ARF) particle counter [3] employs a multiplier phototube to

**1 liter—0.0353 cu. ft.*
1 cu. ft.—28.32 liters.

by A. Lieberman and J. Stockham, *Research Engineers, Armour Research Foundation, Chicago*

Fig. 2: *Prior to entry of "super-clean" area, workers remove dust particles from hands and shoes. Note small Punkah louvers on side wall of air shower (arrow).*

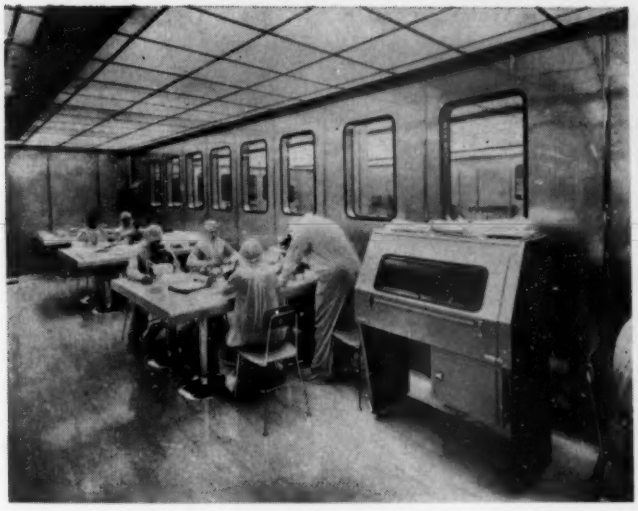


Fig. 3: *Assembly of precision parts is done in quality-control areas such as this. Ledges, where dust particles might accumulate, have been eliminated from equipment.*

measure light pulses scattered by individual particles; these pulses are electrically amplified and counted. Because the amount of light scattered is proportional to the square of the particle diameter, size distribution data is made possible.

The instrument is shown in Fig. 1. The smaller cabinet houses the aerosol-handling system, the optical system, and the photomultiplier with preamplifier. The larger cabinet houses the electronic and readout systems. The aerosol is drawn into the instrument at a rate of 13.2 liters/min. by a vacuum pumping system. When the aerosol concentration exceeds 1000 particles per cc, a diluter is provided to reduce it to one-eleventh of its original concentration. For monitoring clean rooms, the diluter is unnecessary and is omitted. The air to be sampled enters a collimator, where a representative fraction flows down a central tube while the balance is routed through a sub-micron particulate filter to rejoin the aerosol as an annular clean air sheath. The collimated aerosol continues down through the detection zone and out the exhaust. It travels at 11 ft./sec. through the aerosol-handling section and is present in the detection region for about 300 microseconds. At the working concentration, particles are detected individually.

The particles are illuminated by a ribbon-filament tungsten lamp and the light component scattered at 90° is collected by the photomultiplier. The photomultiplier generates a pulse for each particle counted. The height of the pulse is a measure of particle size. The signal pulse leaving the photomultiplier is sent to a six-channel pulse height discriminator, separating the pulses into groups so that the number in each group can be recorded by a digital readout system.

The counting speed of the instrument is limited to 200 counts/sec. by the response of the register systems. The pulse height discriminator is adjustable so that the largest particle detected is either 8 or 64 times the smallest detected. The size limits of the instrument are 0.5 micron and 100 microns in diameter. Means for monitoring pulse shape and for standardizing and calibrating are built into the instrument.

Because of the speed of particle travel and the detection method which does not involve collection, the shape and size of the particles are not affected. This is a major advantage over other methods which may cause distortion through agglomeration, evaporation, or impaction.

The newly completed ultraclean room where the data were obtained is divided into three separate areas: cleaning, grinding, and assembly. Parts are introduced into the cleaning area through an air lock, where they are degreased, cleaned, inspected, and repackaged. In the second area, they are precision ground and inspected again and then passed to the assembly area. The cleaning area contains 450 sq. ft. of floor space, and then grinding and assembly areas 135 and 1100 sq. ft., respectively.

Personnel working in the room don a special lint-free garment and enter the clean room through an air shower "man cleaner."

Air Handling Specs

Static pressures are maintained in all parts of the room: 0.3 in. of water in the assembly area, 0.2 in. in the cleaning and bearing areas and 0.1 in. in the air shower. Independent air supply and filtration systems are used for each of the three areas. Makeup air is prefiltered by a Cambridge Aerosolve® 95 filter. Exhaust air is recirculated, combined with the makeup air, and filtered by a Cambridge Absolute® filter before re-entering the room. Air is supplied to the room through ceiling diffusers and exhausted through return air grilles spotted around the periphery of the room. The object is to maintain a flow of clean air over the assembly tables. There are 20 air changes per hour.

Two sampling points each were located in the assembly and cleaning areas and one was placed in

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Fig. 4: *Workers in quality-control centers wear lint-free garments such as this uniform pictured above. In addition, "booties" are worn as a precaution against dust.*

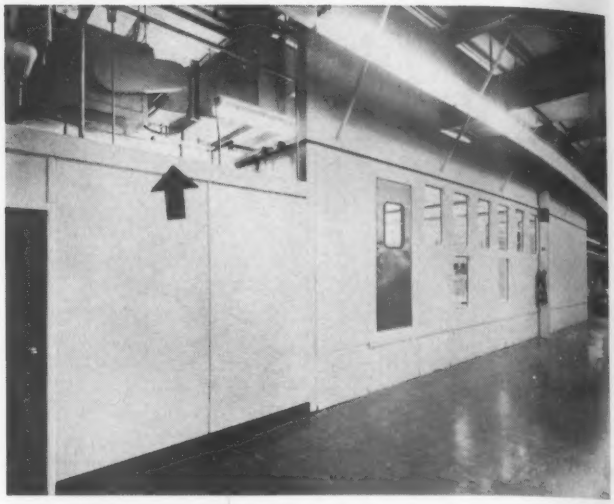


Fig. 5: *Self-contained fan-coil-filter unit, (arrow) with super-interception filters downstream of blower, heating and cooling coils, for white room air handling.*

(Continued from preceding page)

the grinding area. These points were selected to obtain the best possible compromise between requirements for representative sampling and the physical layout of the room and its surroundings.

The sampling points were provided during construction by putting ½-in.-OD metal tube couplings through the wall about 4 ft. above the floor. Six-feet lengths of tubing were attached horizontally to these couplings at the interior of the room. The particle counter intake was attached by an appropriate duct to the couplings at the room exterior. All the tubing was butt jointed and electrically grounded.

The size discrimination level of the particle counter was set to obtain the maximum information under the conditions of the test. That is, at times it was most desirable to cover a range of 1-64 microns or, at other times, 1-8 microns, 0.7-5.6 microns, or 0.5-4.0 microns, to obtain the most informative data. Selection of a particular size range was made after exploratory measurements of the size distribution at the sampling point.

The data were obtained by analyzing successive 2-min. air samples (26.4 liters) until the reliability of the total count was assured. Because atmospheric particles usually have a wide size distribution, the reliability of the data for individual size ranges is not the same. The reliability of the particle count of a few, large particles is less than that of the data describing many small particles. However, the mere fact of the presence of large particles in an ultraclean room is more important than the quantitative measurement. The data as presented, therefore, show not only the concentration of small particles but also the presence of an individual, large particle, which would be undetected by other monitoring methods because of the masking effect of a multitude of small particles.

The new room had been thoroughly cleaned and no operations had been performed prior to testing. With the exception of a leak check, the data reported were obtained from the cleaning area. Simulated operations during the test provided an opportunity to observe the effect of activity on the background particle level.

Next month, Part II of this series discusses the effect of various operations and activities on the particle content of the ultraclean area. ▲▲

Table I. Typical Dust Levels in Urban, Rural, and Machine Shop Air

Particle Diameter		Concentration, particles/liter of air		
in. x 10^5	microns	Urban	Rural	Machine Shop
2.7-5.5	0.7-1.4	47,000	1,250	75,000
5.5-10.9	1.4-2.8	4,300	480	4,000
10.9-21.8	2.8-5.6	1,400	160	180
21.8-43.7	5.6-11.2	120	40	60
43.7-87.4	11.2-22.4	20	0	15

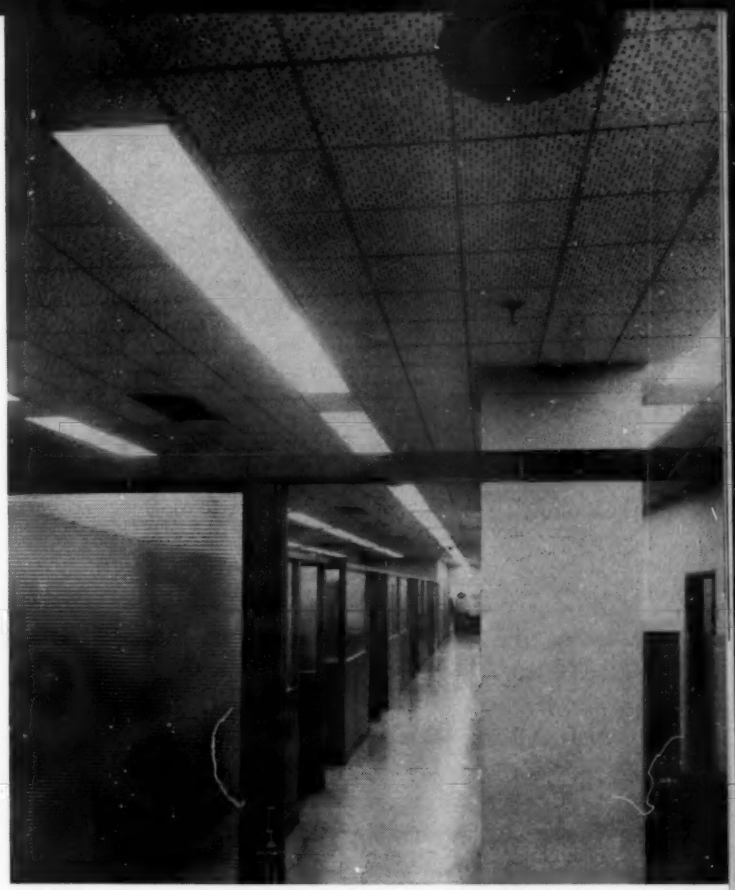
Fig. 6: *ARF's particle counter measures the effect of number of white room workers on airborne particle count and concentration.*

Figs. 2, 3, 4, 5, 6, courtesy of Sperry Farragut Co., Division of Sperry Rand Corp., Bristol, Tenn. Fig. 1 courtesy, Armour Research Foundation.

Air Filtration At Linde Labs . . .

Cleanable filters were hard to clean because of their location, so Linde Labs switched to new type air filters to cut cleaning maintenance and costs.

by A. G. Smalley
Foreman, Maintenance and Construction
Linde Development Laboratory



Corridor showing research offices at Linde labs.

THE THIRD-FLOOR OFFICES in two adjoining buildings of the Development Laboratory of Linde Company, Division of Union Carbide Corporation, Newark, N. J., are air conditioned by a single system. This Linde laboratory is concerned with development and commercialization of processes and equipment for expanding the use of industrial gases in the making, shaping and fabricating of metals.

The air conditioning system is located on the roof of one of the buildings. It cools in the summer, heats in the winter, ventilates in between, and affords year-round humidity control. The space served comprises 27,700 sq. ft. of drafting rooms, administrative and engineering offices housing about 190 employees.

Prior to installation of air conditioning in this top-floor section, summer heat and humidity created difficult working conditions and extreme periods forced occasional early shut-downs. The section also experienced some difficulty with dust which entered through open windows and skylights. For these and other obvious reasons, continuous and efficient operation of the air conditioning system is essential.

Weekly Filter Cleaning Problems

The system employed three banks of filters, one for filtering 100 percent fresh air and two for filtering the mixture of fresh and recirculated air. Originally, each of these banks was equipped with flat, permanent type filters, installed in pairs, one behind the other – one oiled-mesh type and one self-generating electrostatic type in each cubicle of the filter bank.

When the system was first installed, design engineers recommended filters be cleaned on a rigid schedule. Through trial and error best results were obtained by weekly maintenance. This maintenance involved removal, washing, rinsing, drying and replacement of filters in the banks. In addition, the oiled filters had to be re-coated with oil.

Aside from expense in maintenance time (approximately 500 man-hours per year), three major problems were posed by this filter cleaning operation:

a) To permit filter removal, air conditioning had to be shut down during the working day, or overtime had to be paid maintenance personnel.

b) Since the plant elevator does not go to the roof, several men had to remove and carry filters down three stories to the yard. In the yard, three large tanks had to be set up for washing, rinsing and oiling. The tanks could not be set up on the roof since such operations on the roof would be impractical.

c) To reduce downtime, two sets of filters were kept on hand, one set in use, the other stored. In addition to the extra initial cost, storage space was lost.

In appraising the solution to these problems, some details of the unit's operation will be helpful:

The air conditioning system runs about 18 hours a day, 7 days a week. Outside air enters an intake louver on top of this penthouse through a damper-controlled outside air intake. During heating or cooling cycles, this outside air intake handles air at a pre-set rate of 8,000 cfm.

(Please turn to following page)

Air Filtration at Linde . . .

(Continued from preceding page)

The first bank of filters is located in the outside air intake.

Particles in incoming air range from petroleum-catalyst dusts to paint pigments in varying densities. After passage through this first filter bank, filtered air is passed on to the first series of three tempering coils – one steam, one water and one refrigeration coil mounted in series. Cooling is accomplished by means of a 20-ton compressor and well water at about 57° from a 500 ft. deep well on plant grounds. Next, the conditioned air goes to a mixing chamber where it is mixed with re-circulated air. About 75 percent of the air in the system is re-circulated.

The second two filter banks are located on opposite sides of the common mixing chamber. Each bank serves a separate distributing system. The mixed air passes through these secondary filters and through centrifugal fans behind each bank, delivering a total of 31,000 cfm. Each fan serves a multi-zone unit containing the second series of tempering coils. Additional cooling or heating is accomplished by thermostatically controlled dampers which deflect air through tempering coils.

Tempered air from multi-zone unit goes through ducts running between the roof and a dropped ceiling of acoustical tile 9 ft., 6 in. high. Ductwork ranges in size from 48 in. wide by 18 in. deep to 4 in. by 8 in., and feeds seven zones within the two buildings. Overall program control is accomplished by means of standard electrical devices. In addition, an automatic cycling control can be preset to regulate operation of the system according to the day, hour and minute.

Filter Type Switch

Recommendations based on careful consideration of all factors led to replacement of the 72 flat, permanent type filters then in use with 36 cube-type filters – a unique, box-shaped air filter recently developed.

These cube filters are made up of three components: a disposable, 2 in. thick filter medium shaped like an open box; a rust-resistant retainer frame that fits inside the medium to hold it rigid; and a wire basket into which the medium fits. The filter medium is made of DYNEL modacrylin fiber – a synthetic, moisture-proof fiber with a highly irregular cross section and rough surface that tends to trap and hold large quantities of dirt.

In operation, the air stream carries dirt into the cube and onto the front surface of the downstream face of the filter. As dirt builds up on the downstream face, air flow is shunted to the large filtering area of the four sides. Thus, filtering efficiency and low static pressure differential is maintained even after several pounds of dirt have been collected.

Initial installation of the new filters required about 10 man-hours. They were checked for filtering efficiency and resistance for six months. The results:

a) No filter replacement was required for six months after installation of cube filters.

b) Filter maintenance was zero. Static pressure differential remained under the .5 in. maximum.

c) Tanks for washing, rinsing and oiling, and other maintenance items were eliminated.

d) Storage of a duplicate set of filters is no longer required.

e) First replacement of the new filters was easily and quickly effected. Sides of each cube were neatly folded over, with all dirt inside, and the cubes thrown away.

f) In our opinion, the quality of air filtration has improved. There appears to be less accumulation of dirt on ceiling diffusers and adjacent ceiling tile. Also, since oil is no longer used in the filtration system, entrainment of coagulated oil particles in the air stream is no longer a problem.

We estimate that approximately 25 man-hours per year will be required to maintain the new filters, as opposed to the 500 hours previously required. This represents an impressive saving in maintenance time of 475 hours . . . or 95 percent per year. ▲▲

CREDITS

Photos: ***Union Carbide Development Co.***
Ulok Filters: ***Union Carbide Development Co.***
Air Handling Equipment: ***The Trane Co.***
Blower Motors: ***Century Electric Company.***

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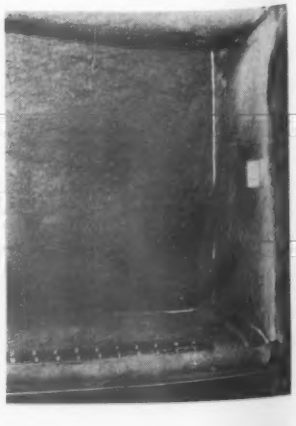
Left: *Basket type filter, with supporting wire holders.*

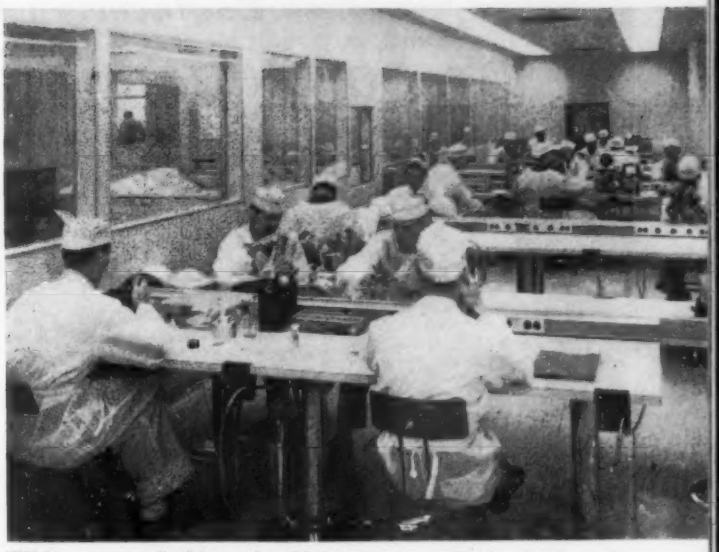


→
Right: *Basket type filter, showing dirt holding after filter has been loaded.*

What to look for when you buy . . .

Dust-Free Clothing For "White Rooms"

It's vital to the success of a super-clean facility that proper personnel clothing be selected. Here are some of the things you should look for in clothing evaluation and purchasing programs.



White room clothing should be free of pleats, tucks, etc. that would trap dust, and be made of lint-free fabric.

by Gerald M. Benstock*

RECENTLY A HALF-MILLION DOLLARS worth of Thor missile engine test pad facility in California blew up with a roar . . . all because of a dust particle far smaller than the radius of a human hair. Dust clogged a LOX (liquid oxygen valve), causing the explosion.

A Michigan plant lost close to $100,000 in rejects because of dust that shouldn't have been in the "White Room."

White rooms, or super-clean facilities, cost anywhere from $25.00 to over $150.00 per sq. ft. to build, depending on how clean the air is to be.

No matter how much the white room costs, however, the best designed super clean air facility is money down the drain if you don't control the human element. This article will be confined to one aspect of the human element in white rooms, that of proper personnel lint-free garments.

The human body is literally a particle producing machine, as far as super-clean rooms are concerned. It throws off body ash, skin flakings, dandruff, dust from shoes, lint from ordinary clothing, hair particles.

The business of proper non-shedding clothing to wrap the human body in such a matter that bodily debris is contained, is an art in itself.

We know of cases, for example, of white rooms otherwise properly designed, that should have done a swell job of keeping the air free of dust particles, but in which the reject rate was high, until personnel uniforms were changed from lint-producing cotton to lint-free 100 percent Dacron.

Simply specifying lint-free garments alone, however, is not enough. Uniforms must fit accurately, have special zippers, preferably have full-length sleeves, have correct *type* of Dacron fabric.

Textile engineers at duPont have come up with a Dacron polyester fabric which is made of many small filaments, about five denier each, twisted and plyed together to form a yarn of 150 to 200 denier. Resultant fabric has a very high breaking strength, far superior to same denier fabric with single yarn construction, and totally free of lint.

Experience shows that a minimum 150 denier fabric is best suited for uniforms, and when made with dull filament yarns, the finished fabric is opaque, which allows the worker to wear a minimum of undergarments.

This fabric is treated with an anti-static substance to eliminate static electricity problems. This treatment is not permanent, must be renewed after several launderings by any of several chemicals in the final rinse of the laundering process. DuPont has a recommended commercial laundering formula adopted by many linen supply firms and industrial launderies. *Plant personnel should not be allowed to launder their own uniforms.*

There is no question that Dacron uniforms are warm, and that they do not have the breathing capacity of cotton; but this is what makes Dacron adaptable for white rooms. Absence of large breathing pores in Dacron stops outward passage of lint and dust from street clothing, body ash and skin flakings from the body. White rooms are air conditioned, which can compensate for impermeability of the uniforms.

Thread used to sew the uniforms should be of like fiber content as the garment fiber; zipper fabric backing also should be of the same fiber as the garment.

(Please turn to page 60)

**Technical consultant and executive vice-president, Fashion Seal Uniforms, Huntington, New York. Mr. Benstock holds an M.E. degree.*

Engineering fundamentals of

Air Sanitation With Ultraviolet Light

Part III

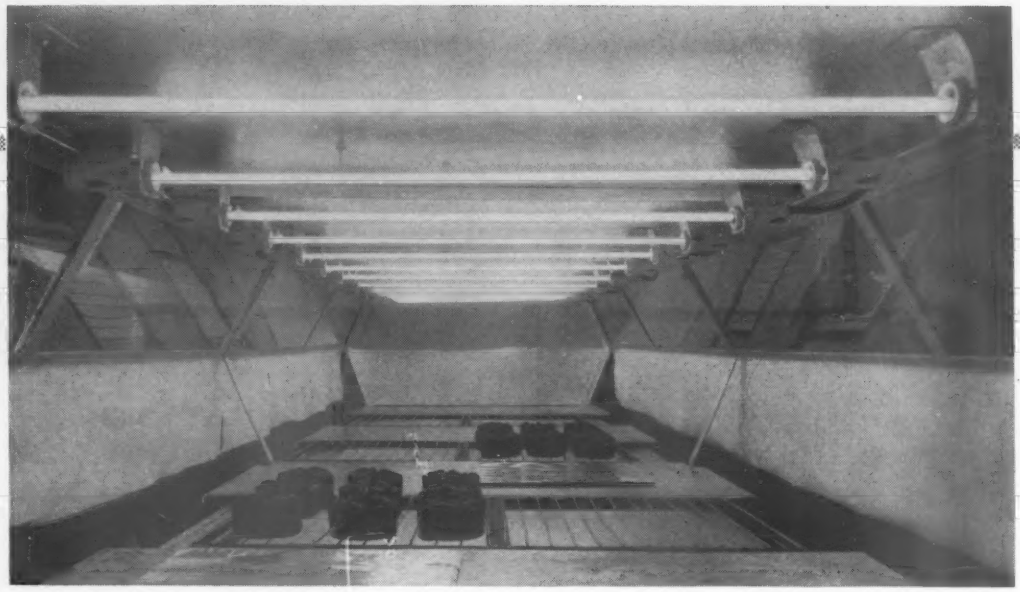


Fig. 1: *Upon withdrawal of goods from oven, air is drawn into product by cooling and contraction of internal gases. Resultant contamination may be eliminated with UV.*

The conclusion of this series deals with ultraviolet air sanitation for baking and meat packing industries. Highlighted is an informative discussion on effects of negative air ionization.

FROM THE INSTANT the food is collected on farms, spoilage and disease-producting organisms are ever present. Methods of pasteurization, sterilization, refrigeration and freezing have been developed to inhibit or destroy these organisms. The ultraviolet lamp has proved to be a useful adjunct to sanitation and preservation methods in the food industry.

One of the first applications of the germicidal tube was in the retardation of mold growth in baked goods. Breads and cakes before baking are heavily contaminated with mold spores and bacteria. However, these are destroyed upon baking. Upon withdrawal of the baked goods from the oven, air is drawn into the bread or cake by the cooling and contraction of the internal gases. The result is a recontaminated product. The contamination may be minimized by cooling the baked goods in an ultraviolet irradiated atmosphere, as shown in Fig. 1. The lamps are placed on the conveyor or the entire room is irradiated by direct radiation. Direct radiation also prevents the growth of mold on walls, observed in some establishments.

Refrigeration retards but does not prevent the multiplication of bacteria and molds. The ultraviolet lamp, to be able to destroy these organisms, must be specially designed to operate at refrigerator temperatures. Ordinary ultraviolet lamps have a very low ultraviolet output and a poor maintenance under such conditions. The cold cathode lamp was specially designed for this application.

Direct radiation, even at very low intensity, falling on mold and bacteria on surfaces of meats or other foods, will destroy or retard their growth. Mold on walls and ceilings will also be destroyed. However, it is impossible, under practical conditions in a meat storage room (Fig. 3) to expose all surfaces of a carcass to direct radiation. It was soon learned that if some of the ultraviolet lamps also generated 1849A radiation, a minute amount of ozone was produced and mold and bacteria on the unexposed portions of the meat were also destroyed. Ozone is produced

by J. C. Hoffman, *Commercial Engineering Dep't.*, and R. Nagy, *Ph.D.*, *Research Dep't.*, *Lamp Division, Westinghouse Electric Corp.*

®—*U. S. Patent Office*

Fig. 2: *Refrigeration retards but does not prevent the growth of bacteria and molds. Ultraviolet lamps, to destroy these organisms, must be designed for low temperatures.*

according to the following reaction:

$$O_2 \xrightarrow[\text{Radiation}]{1849A} 2O \qquad 2O + 2O_2 \rightarrow 2O_3$$

In relative humidity above 50 percent the ozone becomes very bactericidal and fungicidal at concentrations of from 0.1 to 0.01 parts per million (ppm) by weight.

The concentration of ozone in an area is controlled by the number of ozone producing lamps, temperatures, humidity and intensity of bactericidal radiation. The bactericidal radiation 2537 angstroms from the STERILAMP® continuously decomposes a portion of the ozone generated. In addition, the half life of the ozone molecule has been reported by Dr. A. W. Ewell, formerly of Worcester Polytech Institute, to be in the order of three minutes, depending upon temperature and humidity.

With these variables in mind it is then possible to design an installation with the desired concentration of ozone in an area. As an example, Dr. Ewell reports the concentration of ozone in a Tenderay Room to be at maximum 0.1 ppm/wt. In cheese ripening room, 0.2 ppm/wt will extend the holding time by 11 weeks at 59°F and 80 percent to 85 percent relative humidity. In habitated areas, the authors recommend 0.05 ppm/wt or about the quantity of ozone found normally in air. This latter figure is well within the threshold limit of 0.1 ppm established for a seven hour exposure by the American Association of Industrial Hygienists.

Ozone is one of the most powerful oxidizing agents available. All unsaturated organic sulfides, amines, phenolics and aldehydes are readily oxidized. Ultraviolet lamps generating a controlled amount of ozone are sometimes installed in air conditioning ducts for the purpose of oxidizing malodors. No nitric oxides are produced with ultraviolet lamps such as are found with silent discharge ozonators. Ozone producing lamps have also been used in apple storage to destroy molds and to oxidize ethylene gas liberated from the ripening fruit. An excess of ethylene gas will hasten ripening of many fruits.

Most applications of ultraviolet radiations in the food industry are for disinfecting surfaces by destroying airborne organisms. Thus surfaces of cut meat are exposed to high intensity radiation before wrapping and sterile containers are protected from airborne organisms before filling. Another interesting application is the disinfecting of inside surfaces of large liquid sugar storage tanks and other tanks used in food and beverage industries.

A great deal of water is used in the food industry for washing fruits, vegetables, cottage cheese, and butter, as well as the manufacture of beverages. Ultraviolet radiation is used to disinfect this water, because, unlike chlorine, it does not impart an oxidizing property to the water which is detrimental to some foods.

Table I suggests a simple method of determining the number of lamps required for various applications in the food industry.

The Tenderay Process

The first attempt at coordinating ozone and germicidal radiation with refrigeration took place in 1939 at Mellon Institute. Scientists from Mellon Institute, the Kroger Foundation and Westinghouse

(Please turn to following page)

Fig. 3: *Direct radiation, even at low intensity, falling on organisms on meat surfaces, will destroy or retard their growth. Photo courtesy of Kroger Foundation.*

(Continued from preceding page)

were attempting to find a faster, more economical way of tenderizing beef.

It was known that any increase in the tenderness of meat during storage results from the digestive action of enzymes naturally contained in the meat. The speed of this action depends entirely upon the temperature of the refrigerator in which the meat was stored as shown in the following table:

REFRIGERATOR TEMPERATURE (F)	TIME
34°	5 to 8 weeks
40°	20 days
50°	10 days
55°	5 days
60°	3 days
65°	2 days

While the temperature of the refrigerator could be elevated to reduce tenderizing time, the higher it was raised, the more prolific was the growth of mold and bacteria and the more costly the trimming.

At the time of the Mellon Institute experiments, meat was held for tenderizing for 21 days at a refrigerator temperature of about 38°. In the experiments an installation of germicidal STERILAMP® tubes was made on the ceiling of the refrigerator and the temperature of the refrigerator was allowed to climb to 67°. Spray water was also introduced to provide a 90 percent RH. It was found that the germicidal radiation and the controlled quantities of ozone generated by the STERILAMP® tubes were sufficient to maintain mold and bacteria growth at a minimum. Thus beef could now be tenderized uniformly and adequately in 44 hours with a reduction of losses due to trimming. Also, high humidity could be easily maintained and losses due to dehydration were eliminated. The result — a better piece of meat with less waste in one-tenth the time. This method, used to tenderize as much as 170 million pounds of beef per year, is registered at the U.S. Patent Office under the name "TENDERAY PROCESS."

Air Ionization

Thus far, we have explored how the germicidal tube has been employed in the treatment of air through destruction of bacteria and the oxidation of odors. Today the Sterilamp promises a third dimen-

TABLE I

INSTALLATION DATA FOR PRODUCT PROTECTION WITH GERMICIDAL "STERILAMPS®" — DIRECT IRRADIATION

Application	(1) Floor Area per Lamp-Square Feet — G15T8 Hot Cathode Lamp	(2) 782 H&L-30 Cold Cathode Lamp	G30T8 Hot Cathode Lamp
REFRIGERATORS			
Small Walk-in Refrigerators	—	40-50	—
Large Walk-in Refrigerators	—	50-60	—
Holding Rooms	—	50-60	—
BAKERIES, (MIXING, DOUGH, PROOFING, COOLING, AND WRAPPING ROOMS)	40-50	50-60	80-100
BREWERIES, WINERIES, SOFT DRINK MANUFACTURING AND BOTTLING			
Fermentation Rooms	40-50	50-60	80-100
Cooling Rooms	25-35	34-45	50-70
Yeast Rooms	30-40	40-50	60-80
DAIRIES			
Milk, Pasteurizing, Cooling and Bottling Rooms	75-100	100-125	150-200
Ice Cream and Cheese Processing Rooms	75-100	100-125	150-200
FOOD MANUFACTURING AND PROCESSING PLANTS (PROCESSING AND PACKAGING ROOMS, AND STORAGE)	75-100	100-125	150-200
PHARMACEUTICAL, DRUG, AND COSMETIC MANUFACTURING (PROCESSING AND PACKAGING ROOMS)	75-100	100-125	150-200
POULTRY HOUSES			
Brooder Houses and Broiler Plants	50-75	75-100	125-150
Laying Houses and Incubator Rooms	75-100	100-125	150-200
STABLES, CALF PENS AND MATERNITY PENS	75-100	100-125	150-200
KENNELS OR SMALL-ANIMAL PENS	75-100	100-125	150-200

(1) *The lower of the two area figures is recommended for smaller rooms, and the higher figure for larger rooms.*
(2) *782H-30 designates the high-ozone lamp, 782L-30 the low ozone.*

sion to air conditioning: the generation of air ions.

It has been shown that not only during thunderstorms do we have electricity in the air but that it is present to some extent at all times. Some of the oxygen molecules, water vapor and minute dust particles in the air carry a negative or a positive electric charge. These are called negative or positive ions. Ions can be separated from the air by an electric field. Measurements show that some of these ions are very small and can move 1 to 2 cm/sec/V/cm. The medium size ions have a mobility of 0.02 to 0.01 cm/sec/V/cm. The very heavy, sometimes called Langevin ions, are large slow moving particles of water droplets or dust having a mobility of about 0.0005 cm/sec/V/cm.

The number of ions in the atmosphere and their polarity depends upon many factors. It is believed that cosmic rays and radiation from radioactive elements in the soil and air generate most of the ions in the lower atmosphere.

Atmospheric Ionization

Ionization of gases in the upper atmosphere occurs as a result of absorption of very short ultraviolet radiations and even x-rays emitted by the sun. During thunderstorms a greater concentration of negative ions is observed, suggesting that some of the upper air penetrated lower regions. Generally our atmosphere contains less than 1000 ions per milliliter, the majority having a positive charge. Atmospheric pollutions, fogs or mist, decrease the number of negative ions. Wind velocity, barometric pressure, locality and elevation all have their effect on the number and proportion of ions that will be present in the air.

Measurements of air in the vicinity of radioactive spas and near waterfalls have shown a very large preponderance of *negative* ions. Man has visited some of these spas for hundreds of years to obtain relief from certain forms of asthma, chronic bronchitis and other diseases.

The Fohn winds in the Alp Mountains have been reported to carry *positive* ions. During the season when the Fohn blows, suicide and crime rates are reported to increase throughout the mountain communities. In fact it has been reported that judges in these communities are traditionally more lenient during the Fohn season. That ions effect a psychological reaction has been shown by many investigations. But how do ions enter into the field of air conditioning?

Recently, negatively ionized air was successfully used by Dr. Kornblueh of the University of Pennsylvania to relieve symptoms of hay fever. Positively ionized air produced headaches and irritation of the mucous membranes. There are many other psychological effects on man and animal that have been reported. Some of these results are of such vital importance to us that there exists no doubt that further tests will be made to verify these findings. As an example, negative ions have been shown to relieve pain and help to heal burn wounds more rapidly. Chickens raised in an atmosphere of negative ions showed increased weight and decreased mortality. Mice inoculated by Dr. Sokoloff with various types of tumors, or possessing hereditary spontaneous cancer, had a much lower death rate while living in an atmosphere of negative ions than the control animals in a normal atmosphere. It would be of considerable interest if the death rate from certain diseases could be correlated with the degree of atmospheric electricity in a particular location. It is known that certain regions will give relief to asthmatic patients and that certain regions have a much lower cancer rate.

How do ions react with the body to produce a physiological effect? This question has not been answered. The study of the exchange of electrical energy in the body is still in its infancy. It has been postulated that negative ions facilitate the absorption of oxygen in the lungs. Biochemical studies indicate that adrenal, pituitary and other glands of the body are stimulated. All of the life functions in the body are involved in the exchange of electrical energy. Each cell has about a 50 millivolt potential across its membranes (50,000V/cm). Thus, it does not seem too far fetched to believe that a small number of ions per milliliter, e.g., 1000, could alter the bioelectric field in the body over a period of time. It must not be forgotten that an average man may take in as many as five liters of air per minute or five million ions per minute. In tests conducted on the effect of ions on allergies the experimenters used as many as 7500 ions/ml for thirty minutes.

Interest For Engineers

Why should air conditioning engineers be interested in air ionization? The reason is that many modern electrical appliances generate atmospheric ions. It has been reported that electric heaters generate positive ions. Air ions are generated in electrostatic precipitators and may escape into the room. Our mode of living in air conditioned rooms, both summer and winter, creates an atmosphere devoid of ions. It has been stated that a lack of negative ions in air conditioned rooms is responsible for the "stuffy" atmosphere described by many people.

Air pollution is becoming more of a problem every day. Krueger has shown that negative ions stimulate the cilia in the trachea thus removing dirt and mucous from the lungs. Positive ions decrease the ciliary action. Smoke from cigarettes also decreases the ciliary movements. Cauer of Germany has used negative ions for many years in mines to reduce the incidence of silicosis. Probably when more is known about the action of air ions, air conditioning engineers will need specifications for installing ion gen-

(Please turn to following page)

(Continued from preceding page)

erators in air ducts for the prevention of many respiratory diseases and lung cancer.

It is of particular interest that the STERILAMP® ultraviolet tubes with a slight modification will create ions. For the past twenty years these lamps have been used in hospitals, schoolrooms, air conditioning systems, and in the protection of poultry and products. Occasionally reports were received that certain lamps relieved asthma. It was assumed that the minute amount of ozone generated by some of the lamps oxidized the allergens and thus asthma was relieved. It now appears that the relief from asthma was probably a result of negative ions produced by the lamp.

Early tests with poultry showed that ultraviolet radiation will decrease mortality, increase growth and increase egg production by more than 19 percent. Similar tests at a later date did not corroborate these findings. Investigation revealed that the quantity of bactericidal radiation was the same in both series of tests. There was, however, a difference in the amount of 1849 A radiation and in the type of metal fixture. The early favorable results, it is now felt, may have been due to an excess of negative ions produced by the short wave length radiation and the metal fixture, which was probably sufficient to stimulate the endocrine system of the poultry.

Ions have also been shown to retard the growth of mold spores. The question now arises whether the fungicidal action of germicidal tubes in shaded areas of cold storage meat rooms and other applications can be entirely explained on the basis of ozone toxicity. Further research should clear up this point.

Use of Sterilamp®

Although air ions can be produced by radioactive materials, x-rays and high voltage, it would seem that the use of the STERILAMP® tube would be the simplest and most advantageous. The ultraviolet radiation removes an electron from a metal or dirt particle in the air. The electron then attaches itself to an oxygen molecule or to another dust particle to make a negative air ion.

As early as 1924 Picard in Germany used a large aluminum sphere with an ultraviolet lamp to provide negative ions for the therapeutic treatment of respiratory diseases. By properly surrounding the small ODOROUT® bulb with a metal or compound having a low photoelectric work function more than 100,000 ions per milliliter have been produced at a rate of 50 cfm. Larger STERILAMP® tubes produce a much greater number of ions, sufficient to provide a physiological effect.

All tests to date on atmospheric electricity indicate that we may at last be on the doorstep to the control of many of mankind's ills through creation of proper environment. The STERILAMP® has been successful in controlling many infections caused by bacteria or viruses. Now, with the same type of lamp, both objectives can be accomplished. ▲▲

DR. RUDOLPH NAGY, administrative engineer, is employed by the lamp division of Westinghouse Electric Corporation in Bloomfield, New Jersey. Dr. Nagy received his Bachelor of Science, Master of Science, and Doctor of Philosophy degree from the University of Wisconsin. He holds over 18 patents in phosphors and the application of ultraviolet radiation and has published more than 25 articles on these subjects. He is the co-inventor of the fluorescent sunlamp and several new phosphors. Dr. Nagy also received a citation from the federal government for his contributions to the now famous Manhattan Project. Dr. Nagy is a member of the American Association for the Advancement of Science, the American Chemical Society.

JOHN C. HOFFMAN, Commercial Engineer, is employed by the lamp division of Westinghouse Electric Corporation in Bloomfield, New Jersey. Mr. Hoffman received his Bachelor of Science degree from Rutgers University. He also studied at Newark College of Engineering and the University of Vienna. Mr. Hoffman has had papers published on the application of ultraviolet in the meat packing industry and in educational institutions.

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How to Handle Radioactive Contaminated Filters

by **Hugo R. Lopez**
Head, Mechanical Section,
Public Works Division,
U.S. Naval Research Laboratory

Before, it took over 1½ hours to change radioactive contaminated filters. New way, told here, cuts time to less than ten minutes.

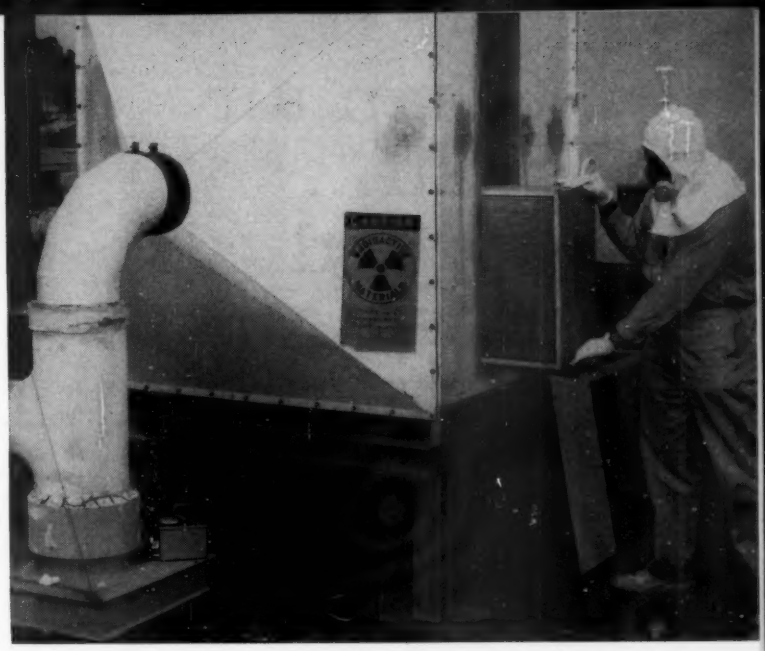

Fig. 1: *Filter holder compartment contains radioactive particle contaminated filter. This new plenum filter-holding device cut filter change time from hours to minutes.*

AT THE U. S. NAVAL RESEARCH LABORATORY, where research in materials and equipment involves extensive use of radioactive and toxic materials, air filtering devices are most important.

The removal of radioactive or toxically contaminated particles from exhaust air had been accomplished with standard fiberglass and absolute type filters. The old filtering devices left a lot to be desired from the view point of personnel safety, since the filtering efficiency was dependent on the seal around filters, especially when using super-interception filters.

In the old filter holder, super-interception filters were held in place by a steel plate about one-fourth-inch thick, having four openings (one each per filter) and innumerable bolt openings to attach the plate to a back-up plate with the filters in between. Wing nuts provided pressure adjustment to insure a perfect seal. This assembly was installed in a weatherproof housing with an access door large enough to enable a man to walk in to replace the filters.

The time required to change the filters amounted to over one-and-one-half-hours, and sometimes more, due to the lengthy procedure, complicated by rust on the bolts and wing nuts.

Hazard to maintenance personnel was the greatest shortcoming of the device, since access at the contaminated chamber for an excessive length of time was required.

In order to provide maximum operating efficiency without hazard to personnel and minimum "down" time, the Public Works Division of the Laboratory designed a radically new filter change device.

The new device, nicknamed "RILO" for its inventors, Mr. Gordon C. Ridings and the undersigned, is called "Radioactive or Toxic Particle Filtering Apparatus, Multi-Stage, Remotely Actuated Positive Seal." (See Figures 1, 3 and 4.)

New Filter Plenum

The new device consists of an inlet plenum or sheetmetal transition from a round or square duct to the filter section.

The first filter stage or coarse filter section consists of four standard two-inch thick throw-away fiberglass filters. Filters rest on a sheetmetal slide that permits filter removal farther away from the access door, without necessity of inserting an arm into the contaminated space.

The second filter stage or fine filter section, utilizes four super-interception filters resting on a metal slide similar to the one used on the throw-away filters. These filters are held tightly in place by a remotely actuated filter press. The pressure exerted on the filters is removed remotely when changing the filters.

The filter press consists of an angle-iron frame with radial stiffening braces welded around a threaded core. The press is driven by an externally mounted hand wheel connected to an angle gear drive. The output shaft of the angle gear drive is connected through a keyed bushing to a threaded shaft fitting the filter press core, as shown in Fig. 4.

The filter press rides on angle iron ways. Four springs, located one each at each angle iron way, exert a pressure of approximately five pounds each to insure smooth forward movement and even pressure against the filters.

Filter changing time has been cut to less than ten minutes, and hazard to maintenance personnel has been completely eliminated.

Blower Connection

The outlet or blower connection consists of another sheet metal plenum or transition from the filter section to a round duct connection to fit the blower used. The apparatus is internally coated with a "cocoon" or strippable paint, easily removed once the level of contamination within the enclosure reaches maximum allowable.

The device can be constructed in

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White Room Symposium . . .

(Continued from page 21)

the many problems relating to different industry requirements for a 'White Room.'

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Future White Room Meetings

The ASCCA plans future meetings, on a larger scale than the one-day session in Tempe. For more information on these meetings, and on white room problems, keep tuned in to AIR ENGINEERING.

▲▲

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of AIR ENGINEERING.

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Feature articles are indexed three ways for your convenience . . . alphabetically by author, by title and by major activity classification (heating, air conditioning, etc.).

As a further aid in locating articles to help you with a particular problem, we have coded the article index by the industry or industrial process involved. To use this code, select the industry or activity that matches your problem and run down the list of articles in the index. These codes are in boldface type. Schools, for instance, are coded **(A)**. Here is the code:

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Editor:

Will you please advise if it will be possible for you to make available Part #1 of "Methods for Trapping Beryllium Dust" which appeared in the July Issue of AIR ENGINEERING.

E. K. Spaulding
Plant Facilities Engineer
Hughes Aircraft Co.
Tucson Div.

Comment From South America

Editor:

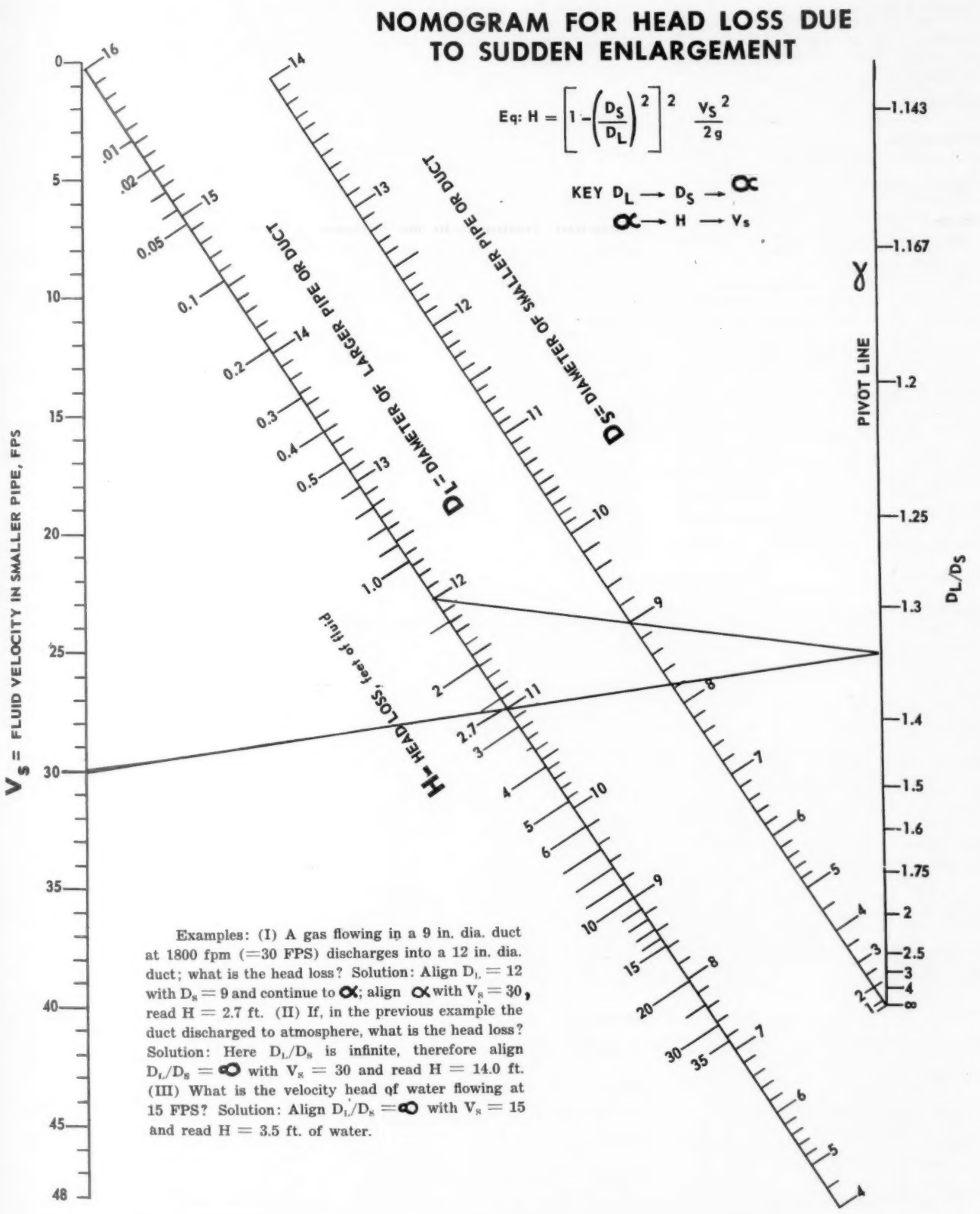
We were fortunate in obtaining recently a copy of the November 1959 issue of AIR ENGINEERING Magazine in which we found a reference to your publishing company.

We are writing to request any information you may have available on hospital air conditioning. We are especially interested in obtaining information regarding culture plates to discover the quantity of air-borne bacteria in Operating Room and Nurseries.

If you are unable to supply this information perhaps you would be kind enough to recommend an additional source.

Sister M. Anita, S.C.M.M.
Administrator
Hospital Sagrada Familia,
Venezuela

For Gases . . . Or Fluids . . .



Examples: (I) A gas flowing in a 9 in. dia. duct at 1800 fpm (=30 FPS) discharges into a 12 in. dia. duct; what is the head loss? Solution: Align $D_L = 12$ with $D_S = 9$ and continue to $\propto$; align $\propto$ with $V_S = 30$, read $H = 2.7$ ft. (II) If, in the previous example the duct discharged to atmosphere, what is the head loss? Solution: Here D_L/D_S is infinite, therefore align $D_L/D_S = \infty$ with $V_S = 30$ and read $H = 14.0$ ft. (III) What is the velocity head of water flowing at 15 FPS? Solution: Align $D_L/D_S = \infty$ with $V_S = 15$ and read $H = 3.5$ ft. of water.

by F. Caplan, *Kaiser Engineers, Oakland, Calif.*

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YOUR SECOND BIGGEST MARKET is Western Europe where rapidly rising living standards mean a big chance for you to cash in now on opportunities to produce and sell under local licensing arrangements with no cash investment. Since 1954 I have successfully operated as the promoter, organizer and supervisor of European business for a select group of top American heating, ventilating and air conditioning concerns. Can take on one good additional account now. If you are already operating in Europe, but feel the need for better coverage and closer supervision, or if you are now thinking of getting set up, it will pay you to write now and see me in Chicago at the ASHRAE Show. Your products can make more money for you in Europe now. J. J. LA RUS, European Sales & Licensee Supervisor, 2, avenue Le Notre, Marly-le-Roi (S & O) France.

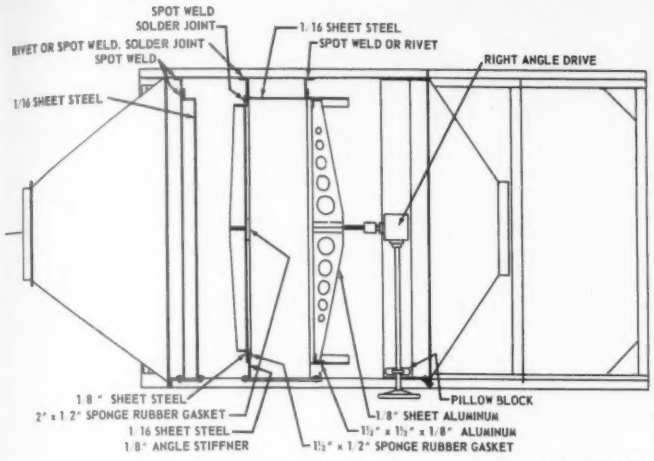

Fig. 2: *Drawing shows construction of filter holder and changing mechanism.*

Filters . . .

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a variety of sizes by stacking two or more filter sections. The accessories that are used with this apparatus consist of:

1. A radiation monitor in the intake of blower to shut-off blower if contaminated air gets past the filters.

2. A monitor sensing toxic gases can be installed to perform as the radiation monitor.

3. A filter gauge has been installed to notify operating personnel of filter condition. It will light a bulb or energize a buzzer in the laboratory served by this apparatus.

4. A weatherproof manometer is installed at the apparatus to check blower operation.

5. Self-sealing quick-disconnect connections are available to obtain air samples when desired.

The filter press can be provided with a hydraulic or electro-mechanical type mechanism for automatic operation.

Contaminated filters removed from the filtering apparatus are taken out by personnel wearing protective clothing to suit the operation, and the filters are placed in containers designed to handle contaminated materials, with minimum exposure to maintenance personnel. ▲▲

Secondary Smelting . . .

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process must necessarily be determined after a thorough study of the particular problem. However, the usual atmosphere for melting scrap metal is a neutral one, neither oxidizing, nor reducing. *A neutral atmosphere is one in which the air supplied to the combustion process is almost exactly that required to burn the fuel completely. A reducing flame is one which has insufficient air to maintain complete combustion and conversely an oxidizing flame contains more air than is necessary for combustion of the fuel.*

An oxidizing flame, containing free oxygen at an elevated temperature, will tend to burn metal, forming a metallic oxide or fume which goes up the stack. If free oxygen is kept to a minimum, the burning of metal will be reduced and the need for a collector may be eliminated or at least reduced in size.

It is difficult to obtain a truly reducing atmosphere with an oil flame. With a limited amount of air and less than perfect atomization and mixing, complex hydrocarbons are formed with visible results of smoke, carbon deposit, or both, as well as unpleasant odor. However, if good combustion conditions are maintained, oil can be burned smokelessly to maintain a neutral condition. Smoke emitted from a furnace is not a positive indication of a reducing atmosphere. Smoke is produced also when combustion is poor. Coal or gas can be used for reducing purposes more easily without causing nuisance.

Loss of metal in the furnace is a major factor in the smelting process. Of course, reclaimed fume has a value, but it small compared to the worth of the metal. It is not unusual for a charge of metal scrap to lose 10 percent by weight up the flue. Some of the loss is due to combustibles and some loss is

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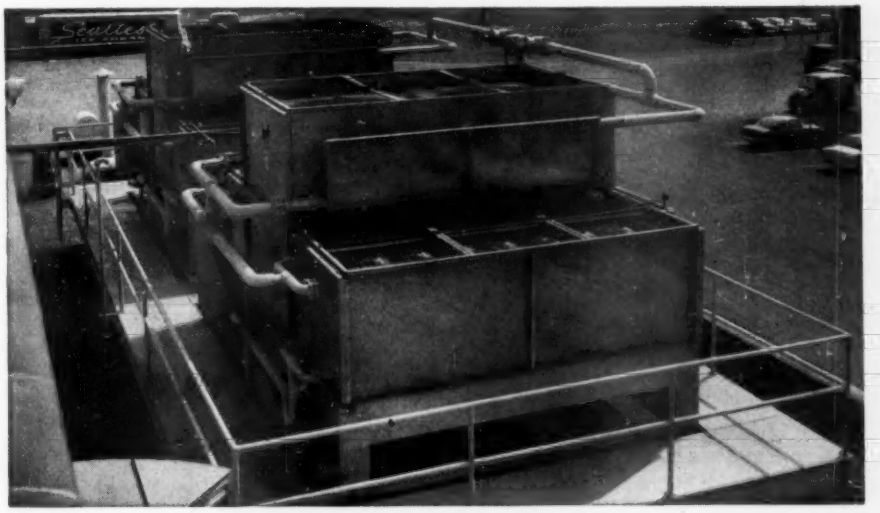

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These Niagara condensers are lower in first cost and assure you of trouble-free automatic refrigeration. Special features: "Aeropass" coil removes super-heat to give you condensing at lower temperatures and prevent loss of capacity by the scaling of condenser tubes; "Oil-out", oil separator between pre-cooling and condensing coils gives you always an oil-free system; "Panel-Casing" construction gives you access to every part of the condenser for inspection and maintenance. Operating engineers say these condensers "save half the work of running a refrigerating plant". Managers who know costs and profits prove that Niagara condensers bring them great returns in power savings, water savings and reduced maintenance expense.

Write for Bulletins 131 and 142.

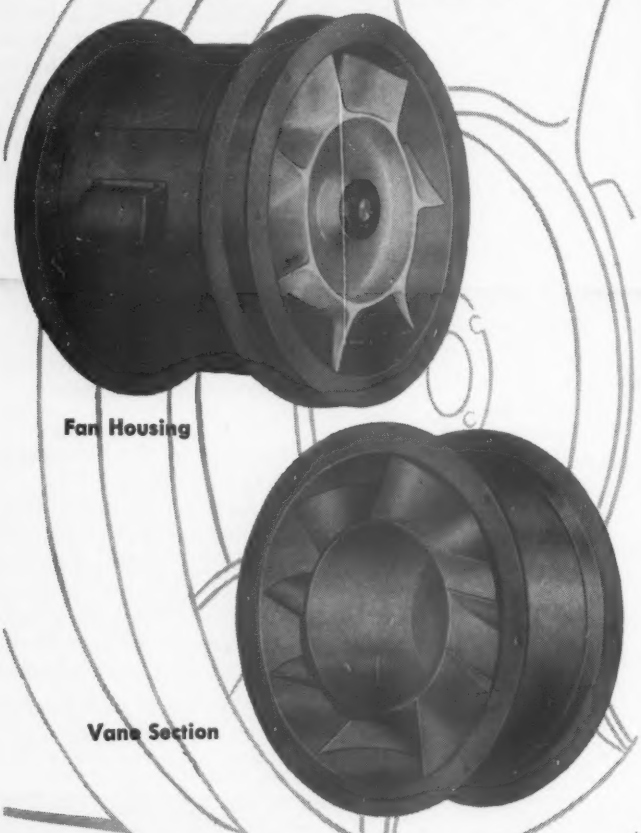
NIAGARA BLOWER COMPANY

Dept. AIR-12, 405 Lexington Ave., New York 17, N. Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

another outstanding design development from

Aerovent



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vaneaxial
fans

with removable vane sections

Engineered for high-pressure, high-velocity air distribution systems, these units feature a unique removable vane section which simplifies installation and permits easy access for routine cleaning and maintenance.

Available in 30 models in sizes 18" to 48" for capacities from 3230 to 67,300 cfm with special design features for all application requirements.

Write for Bulletin 475

Air deliveries of all Aerovent equipment are tested and rated in accordance with established and accepted codes and each unit is guaranteed by the manufacturer to deliver its rated performance.

CERTIFIED PERFORMANCE

Aerovent

Aerovent
FAN COMPANY, INC.
ASH AND BRIAN STREETS PIQUA, OHIO

White Room Clothing

(Continued from page 45)

Tailoring is an important aspect of uniform selection. The uniform should embody "straight-line" tailoring, which means elimination of all dust deposit areas on the garment. Pockets, pleats, tucks, belts and kindred dust collectors should be eliminated. All zippers should be covered with a fly, both front and back, to prevent dust accumulation and seepage.

Sleeve ends should be securely yet comfortably closed, with a soft elastic developed for this purpose.

A uniform of the fabric and tailoring as described above will be a lint-free, dust-proof garment which allows the wearer maximum comfort. Comfort is an important factor in white room uniform design, since research has shown that garments which tend to bind limbs impose slight strains which after several hours build up efficiency-reducing fatigue.

Even with the best white room uniform, air showers and air locks should be employed ahead of clean areas. Dust can deposit on the uniform during storage, even if the storage is in the air-lock.

To complete the uniform, white room personnel should wear fabric caps, hats or hoods, gloves and boots, of the same fabric as the uniform. A variety of head coverings are available to meet varying needs, for men and women.

Since uniform function is a variable depending on the industry, and white room criteria, the uniform manufacturer should be consulted before the white room facility is activated, to make sure proper lint-free garments are on hand when required.

The uniform is only one link in the chain of equipment needed to produce a dust-free environment, but without the proper garment your investment in these facilities may well be greatly reduced. With the proper garment your investment will be maximized, dust-sensitive products protected. ▲▲

G-E Jet Engine Plant

(Continued from page 32)

fortable results. When chilled water is not available, outside air is used in quantities up to 100 percent, as required. The evaporative cooling system can operate only when no chilled water is available, and when the outside temperature reaches a set point.

The relief dampers and general exhaust are of sufficient capacity that neither the 100 percent outside air flow or the evaporative cooling have any adverse effect after leaving the office area.

If at a later date, packaged air conditioners should be required in the areas now air conditioned entirely by plenum air, the temperature in these zones would also be controlled by packaged air conditioners. In that event the proper proportions of cooling by plenum air could be controlled by wet bulb thermostats in the outside air streams. ▲▲

Secondary Smelting

(Continued from page 59)

accounted for in slag. Overall furnace loss, however, is an excellent indicator of the the amount of furnace discharge through the stack.

The use of flux to control furnace operation has not been fully developed, but its importance cannot be over-emphasized. Some smelters have conducted private research on the use of different fluxes which consist of more than silicates and borax. Many claim superior performance for their own mixtures. With the tremendous advancement of chemical research and in the improvement of other fluxes (i.e. welding fluxes) it is our opinion that much can be done that will help the waste material smelter.

Advantages Of A Good Flux

The flux used in a furnace can be beneficial in preventing the contact between the metal and surrounding atmosphere. A good flux will melt easily and cover the metal quickly with a film. Its own vapor tension should be high enough to resist the throwing off of metal vapors. Yet it should not prevent the flow of heat to the melt and, of course, should produce desired metallurgical results.

Charging light weight scrap can often give trouble due to rapid oxidation of the thin pieces. A good flux will produce a slag bed that can protect the metal. Experiments have been tried with some success on the use of slag to prevent contact with atmosphere while hot metal is in the ladle.

All the answers to a successful air pollution control program for the secondary smelter are not known. We hope the above excerpts from our experience may help to promote clean air. ▲▲

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of AIR ENGINEERING.

If you wish to contact manufacturers directly, street addresses are given. But please mention you saw it in AIR ENGINEERING.

INDUSTRIAL PLANTS like Sylvania Electric must maintain rigid quality standards in their precision work. Lint problems have been minimized with uniforms of "Dacron".

LINT-FREE UNIFORMS

start with DACRON® polyester fiber

Lint, often found to be a cause of problems in quality control, is absent with uniforms of "Dacron"* polyester fiber. The smooth surface of "Dacron" just can not generate lint. But that isn't all—uniforms of "Dacron" provide built-in economy and lasting good looks as well.

Plant personnel get a vacation from upkeep problems, too—uniforms of "Dacron" resist wrinkling, endure machine washing and drip drying, need only touch-up ironing.

FOR SPECIAL ADVICE ON UNIFORMS write: Uniform Counseling Service, E. I. du Pont de Nemours & Co. (Inc.), Textile Fibers Dept., Centre Road Building, Wilmington 98, Delaware.

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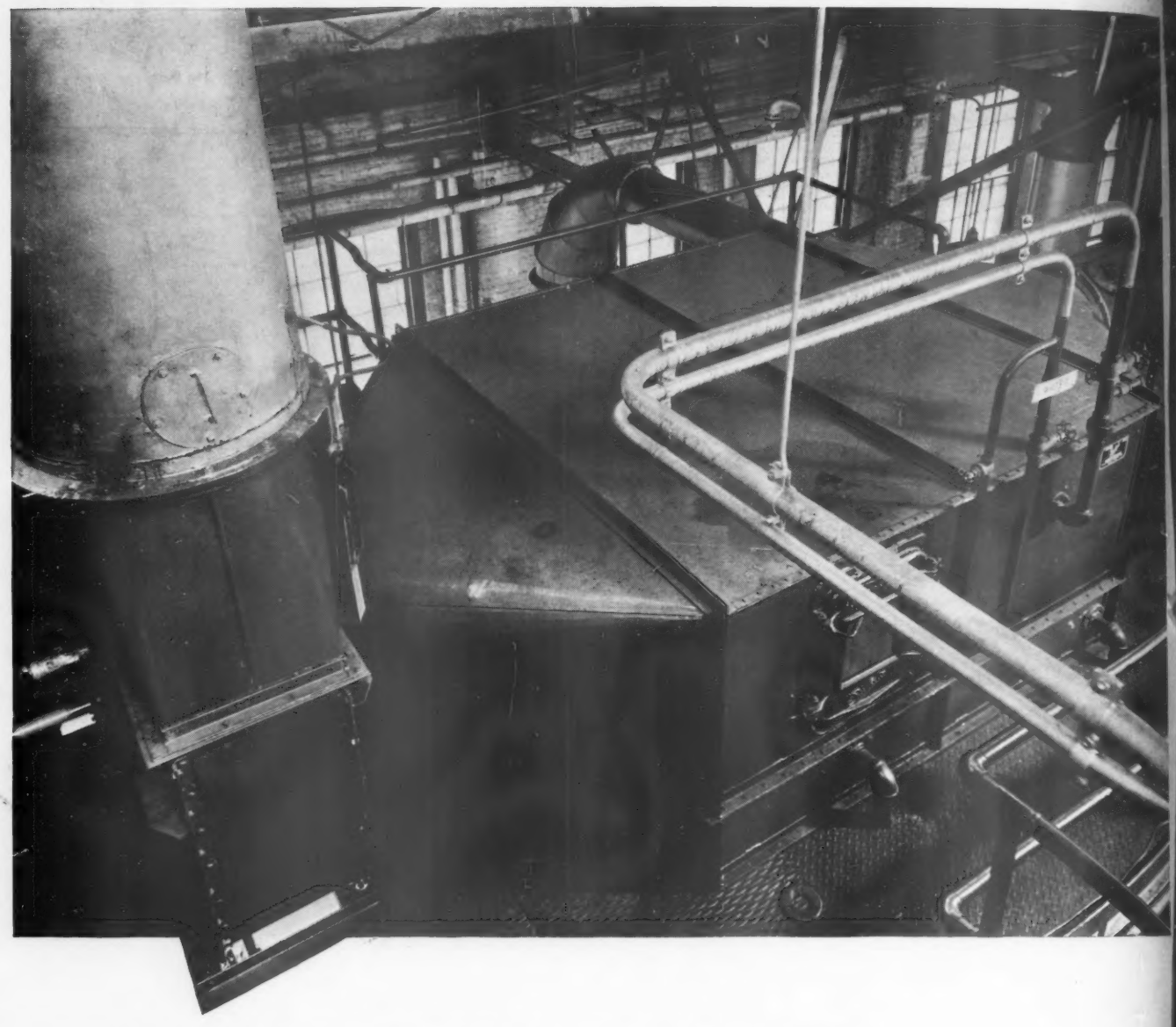
*"DACRON" IS DU PONT'S REGISTERED TRADEMARK FOR ITS POLYESTER FIBER. DU PONT MAKES THE FIBERS, NOT THE FABRIC OR UNIFORMS SHOWN.



AIR POLLUTION PROBLEM?

'Buffalo' Gas Absorbers can remove entrained particulate matter from dryer vents, eliminate noxious gases from purge streams, scrub or absorb corrosive acid mists and fumes from vent systems, you name it—chances are a 'Buffalo' Gas Absorber can clean it up.

They can be designed to provide the optimum capacity and efficiency to render harmless atmosphere discharge at minimum first cost with proven low-operating cost.

To meet special corrosion requirements, these units can be constructed of carbon steel, rubber lined steel, stainless, and light weight reinforced plastic. Bulletin AP-225 gives details.

Whatever your air pollution problem, 'Buffalo' probably has the answer in its wide range of air handling equipment. Contact your 'Buffalo' Engineering Representative or write direct.

"Buffalo"

BUFFALO FORGE COMPANY

Buffalo, New York

American Blower & Forge Co., Ltd., Kitchener, Ont.

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'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

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